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**Maramara**

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(54) **WAVE ENERGY CONVERSION SYSTEM**


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(51) **Int. Cl.**

| | |
|---|---|
| ***F16H 35/00*** | (2006.01) |
| ***F03B 13/18*** | (2006.01) |
| ***F03B 13/20*** | (2006.01) |

(52) **U.S. Cl.**

CPC ......... ***F16H 35/00*** (2013.01); ***F03B 13/1815*** (2013.01); ***F03B 13/20*** (2013.01); *F05B 2260/403* (2013.01); *F05B 2260/406* (2013.01); *Y02E 10/38* (2013.01)

(58) **Field of Classification Search**

CPC ........... Y02E 10/38; Y02E 10/28; F03B 13/20
USPC ............................................................ 290/53
See application file for complete search history.



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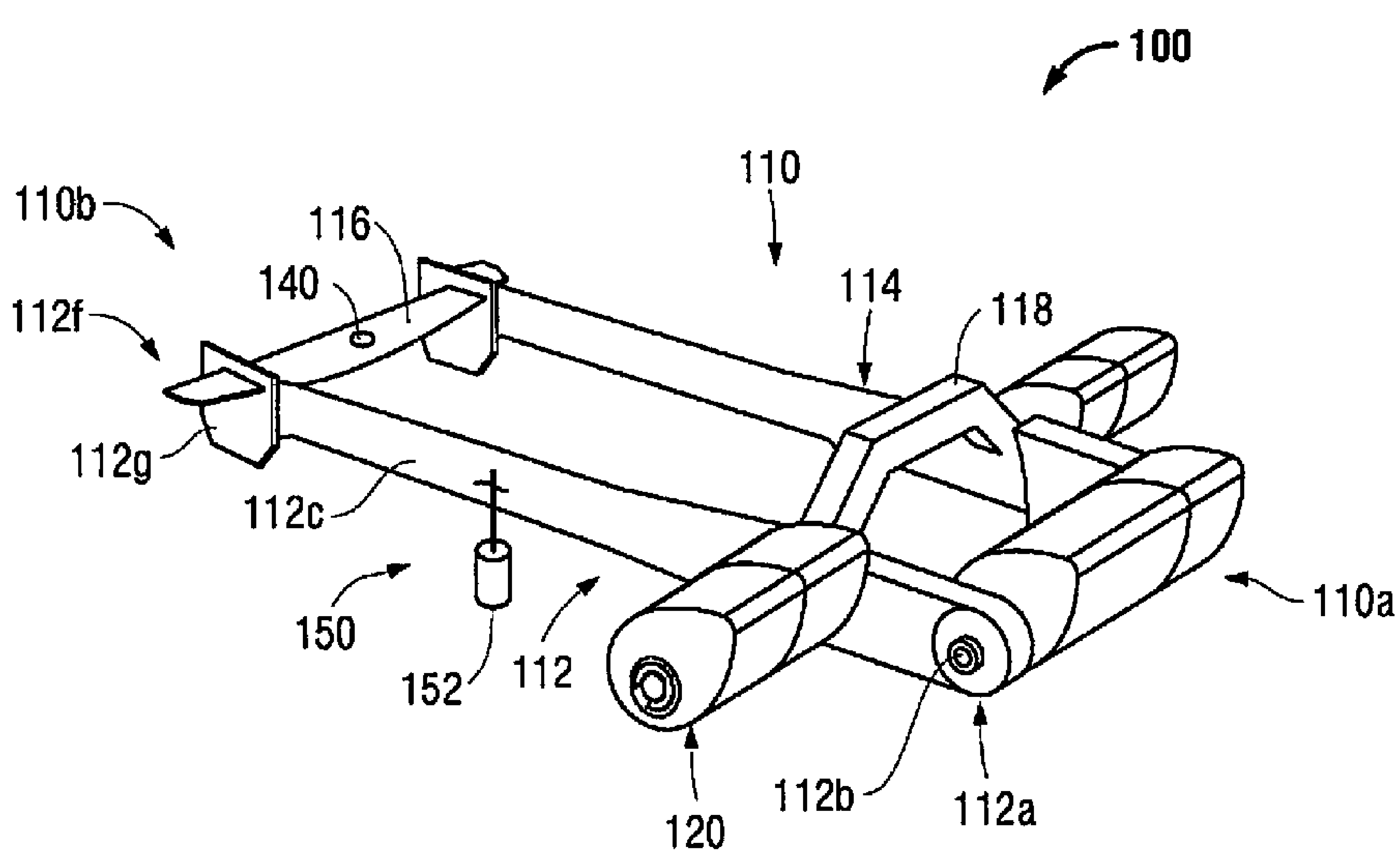
(57) **ABSTRACT**

A wave energy conversion system is provided including a pod, multi-radius energy transmission mechanism, and an electrical generating device. The pod is rotatably supported by a platform structure and the multi-radius energy transmission mechanism is in mechanical communication with the pod. The multi-radius energy transmission mechanism is configured to transmit a variable torque over a range of motion and is in mechanical communication with the electrical generating device.


**15 Claims, 13 Drawing Sheets**



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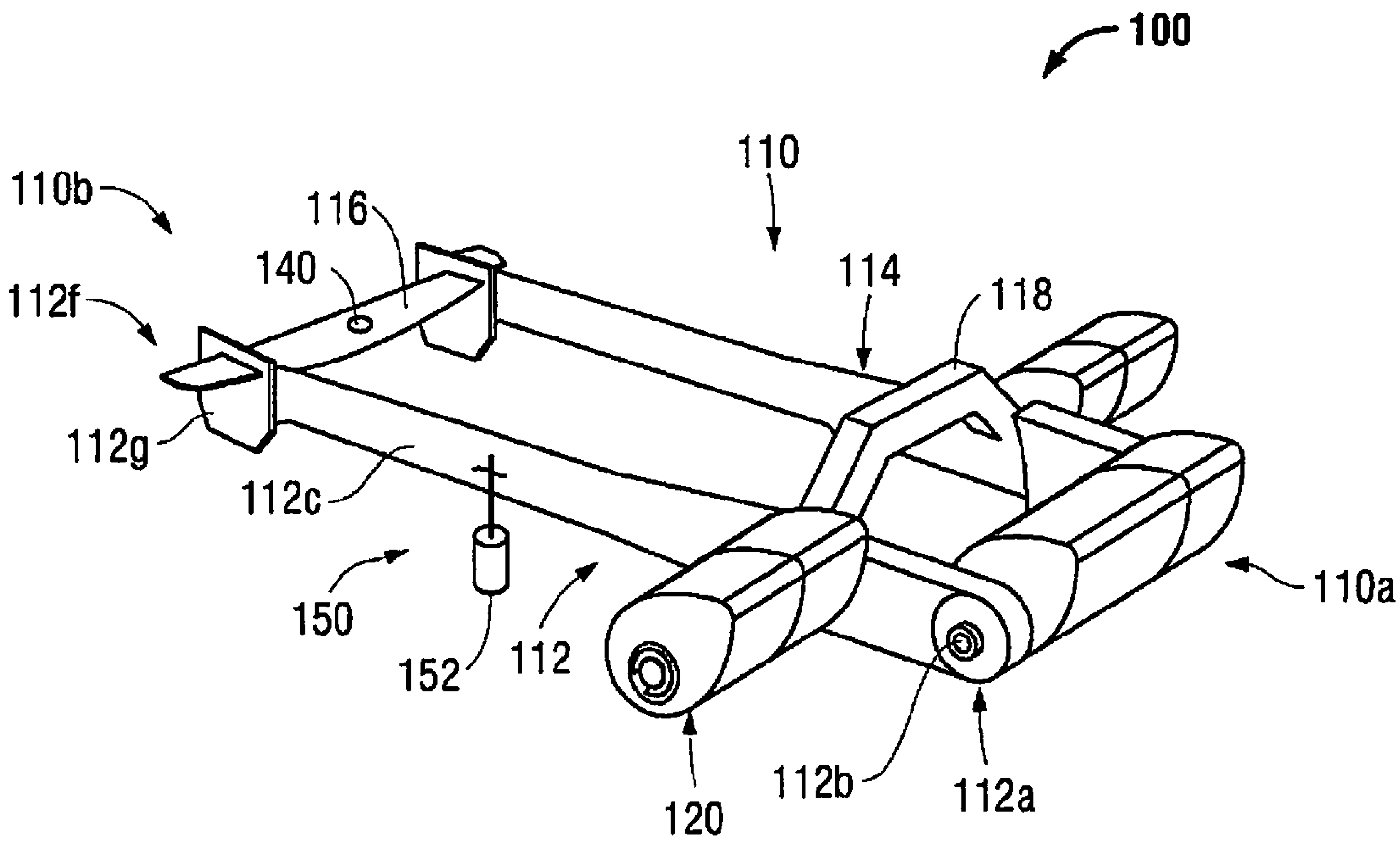
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110
110b
116
140
114
118
112f
112g
112c
150
152
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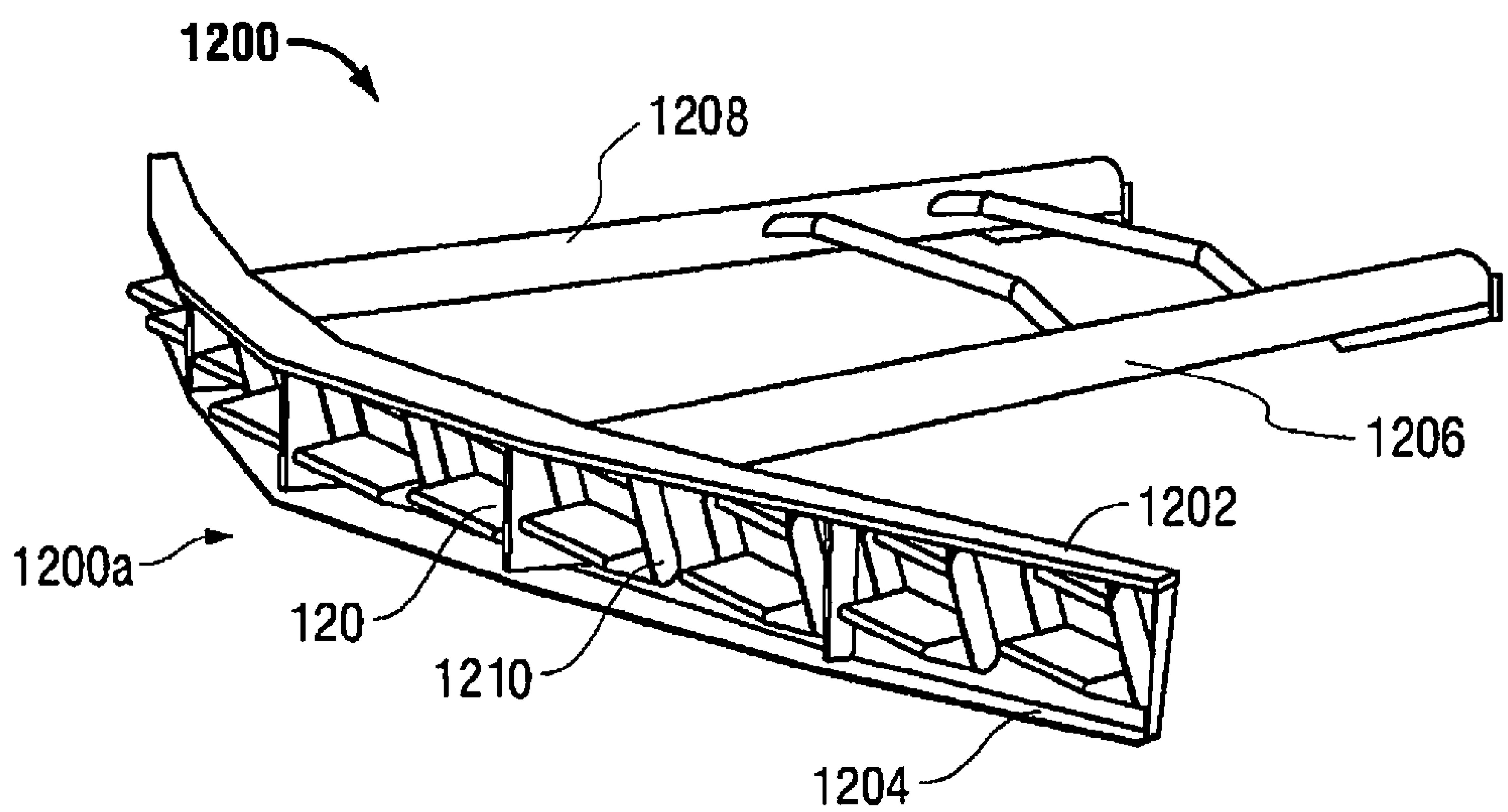
110a
120
112b
112a

FIG. 1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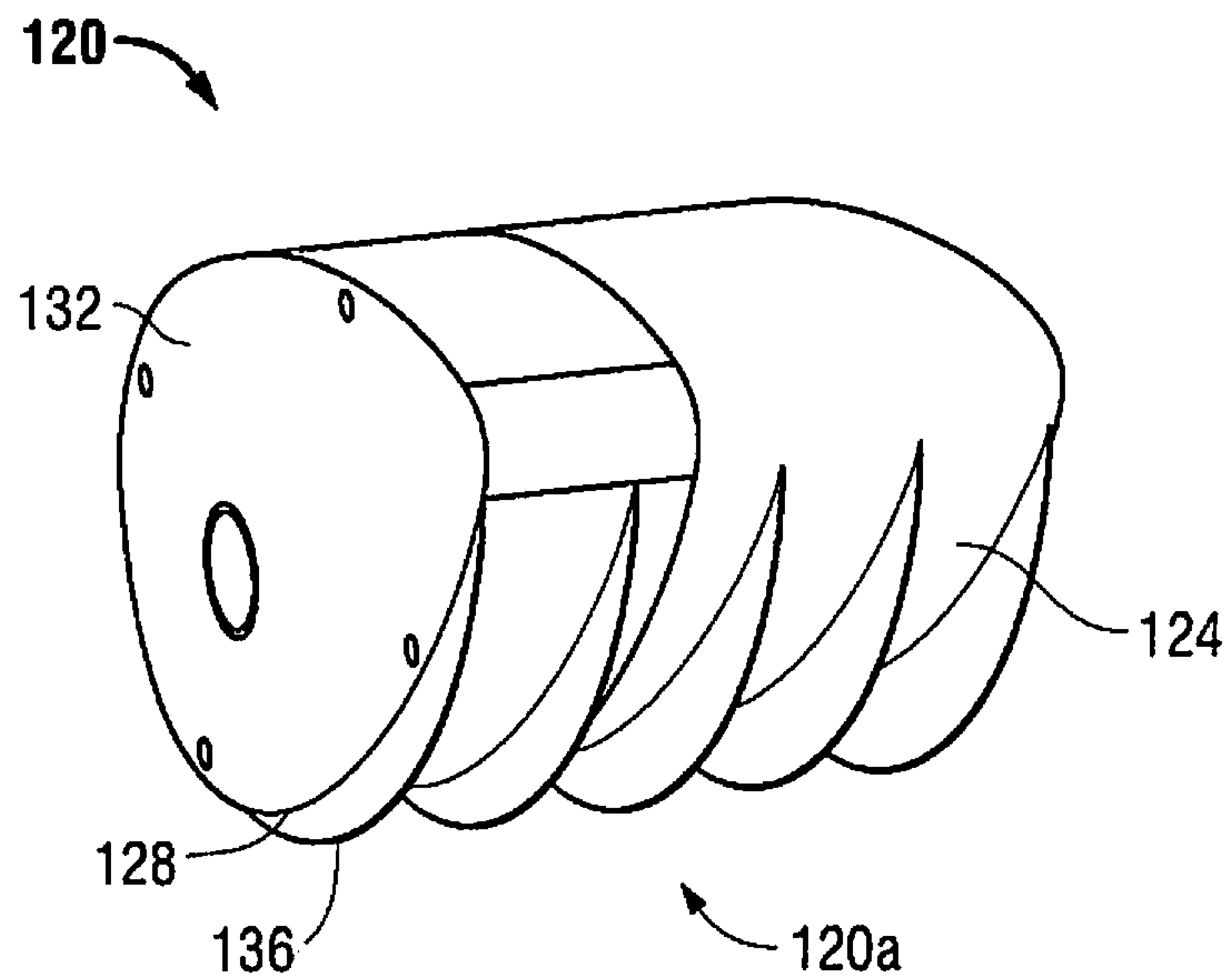
1206
1202
1200a
120
1210
1204

FIG. 1A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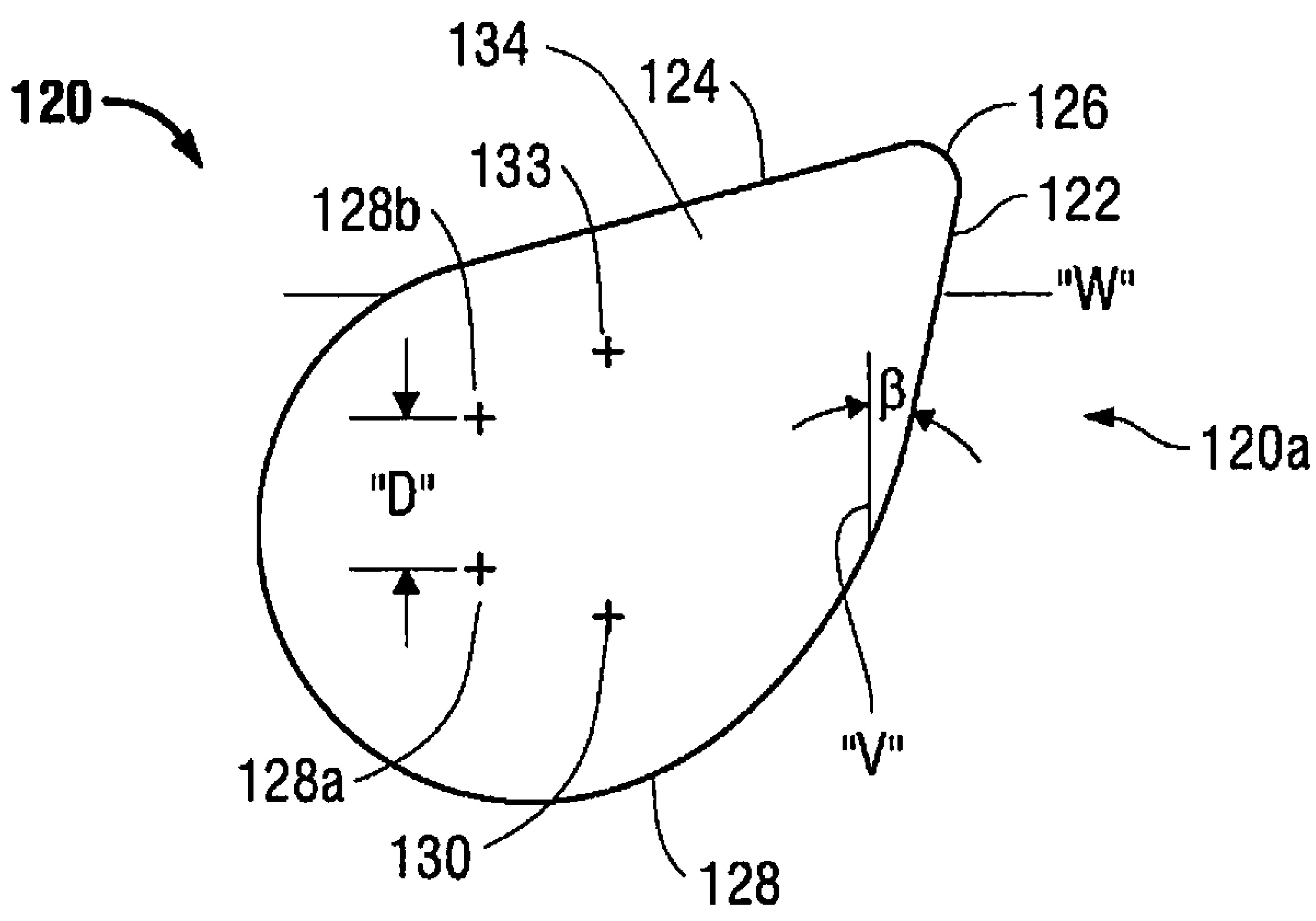
132
124
128
136
120a

FIG. 2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122
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"W"
β
120a
"D"
"V"
128a
130
128

FIG. 3

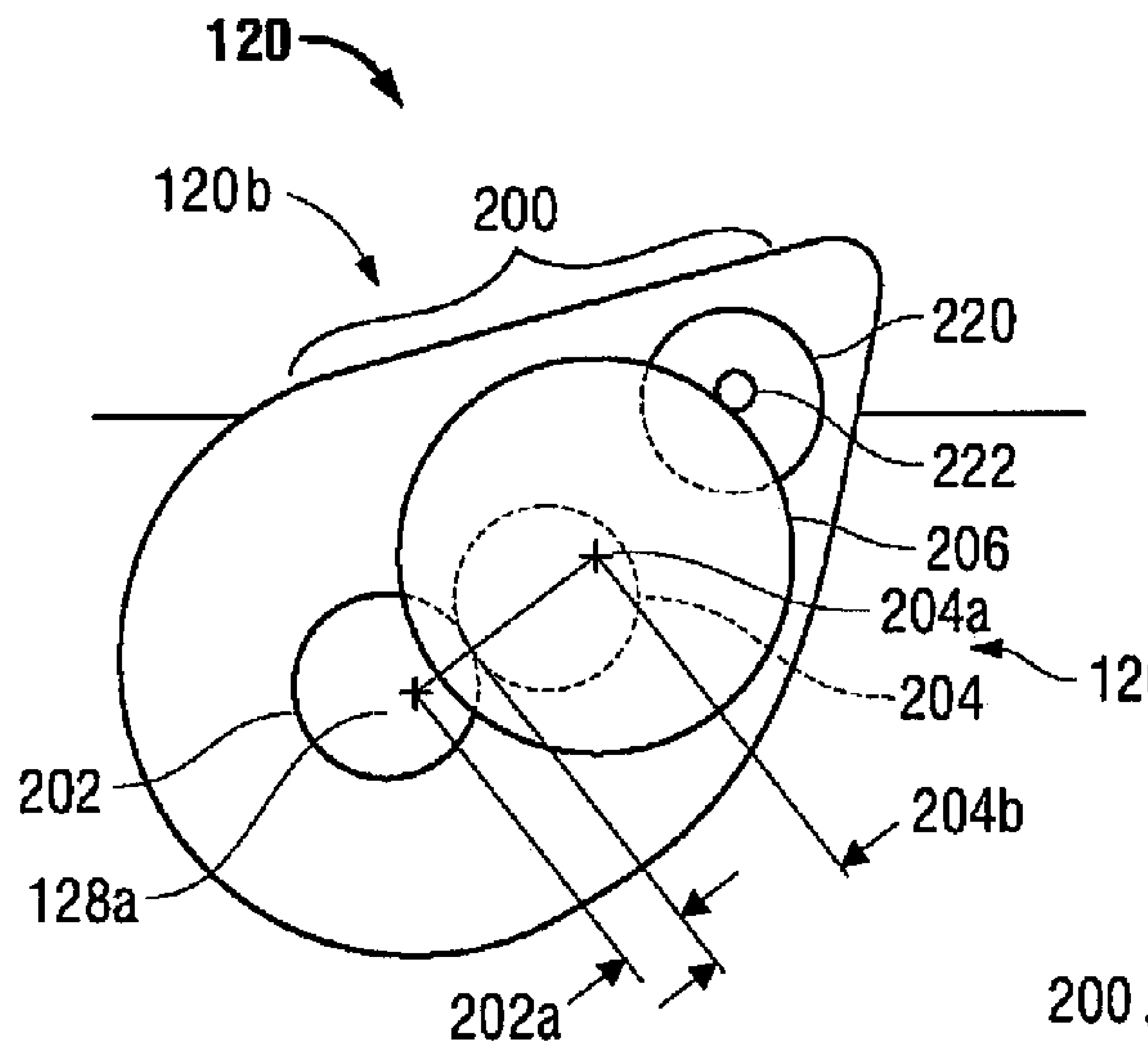



FIG. 4

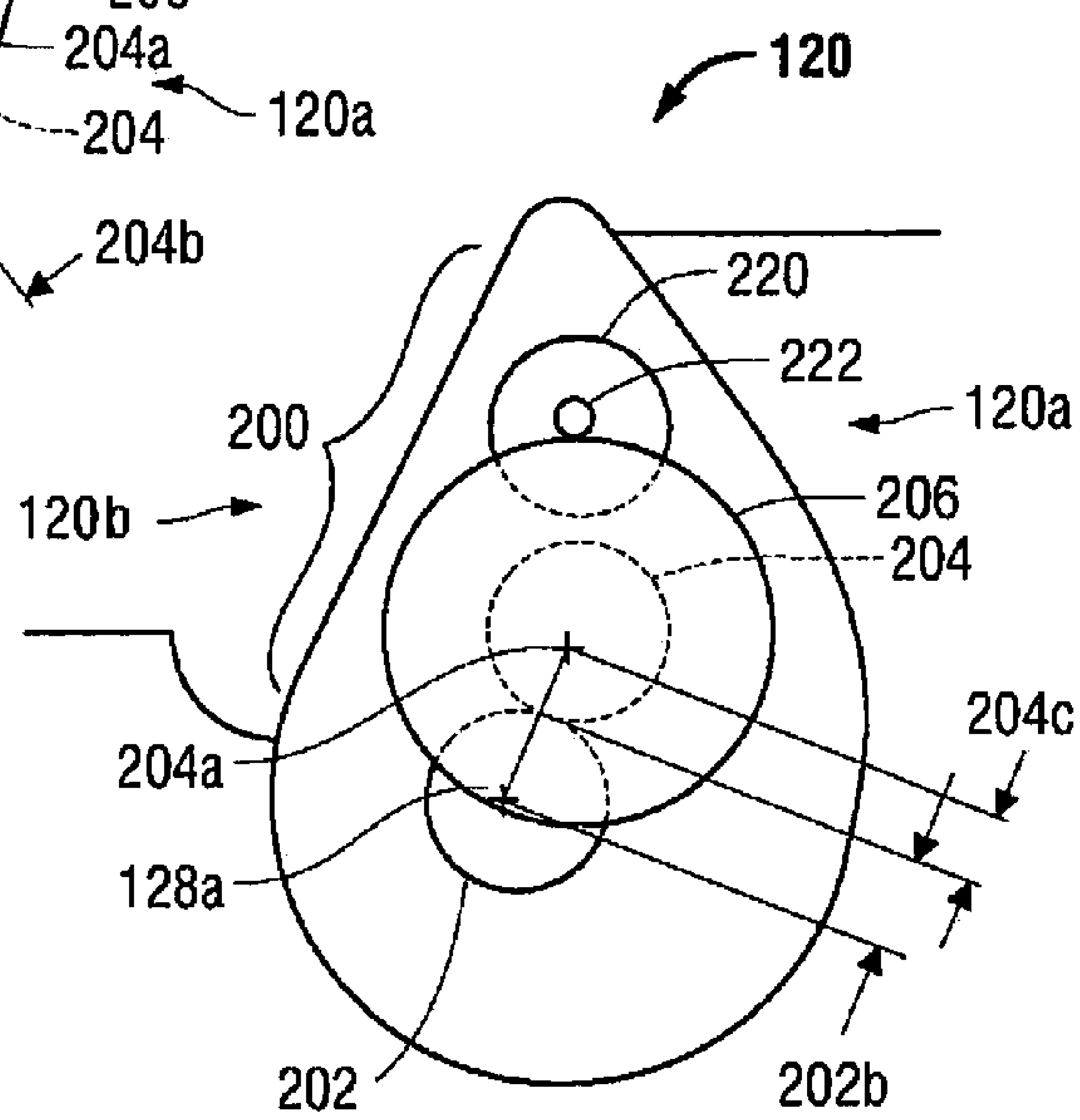



FIG. 4A

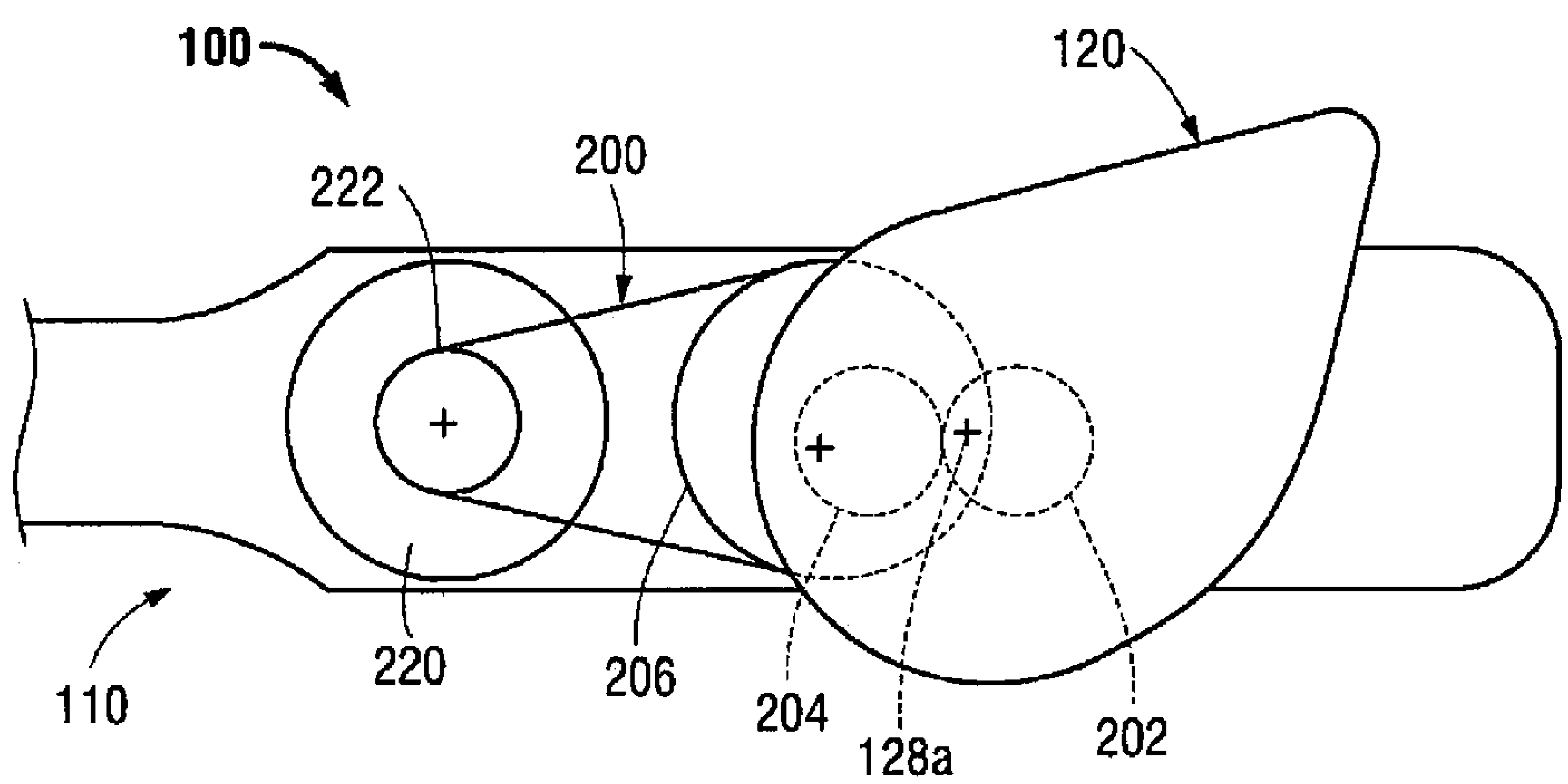



FIG. 4B

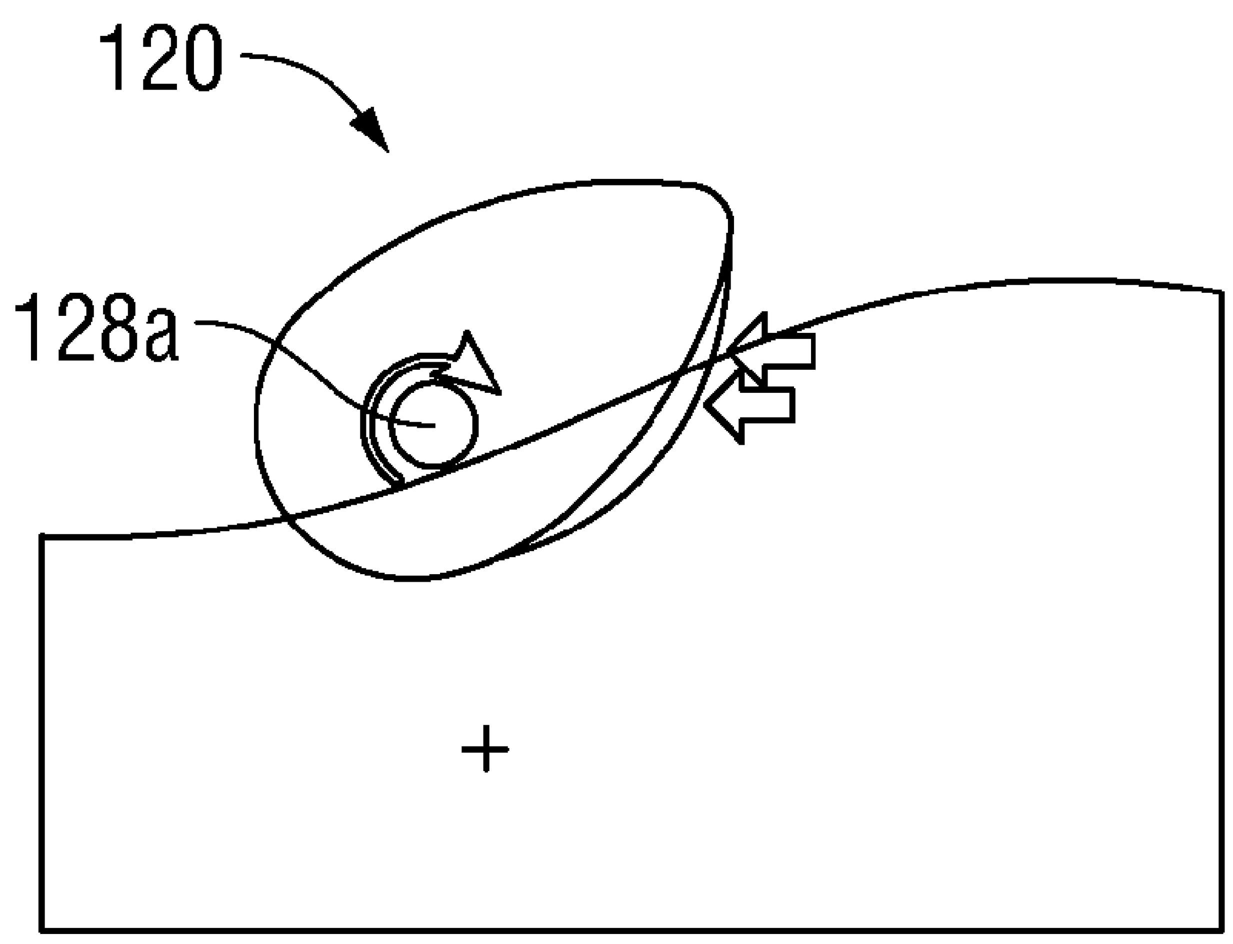



FIG. 5A

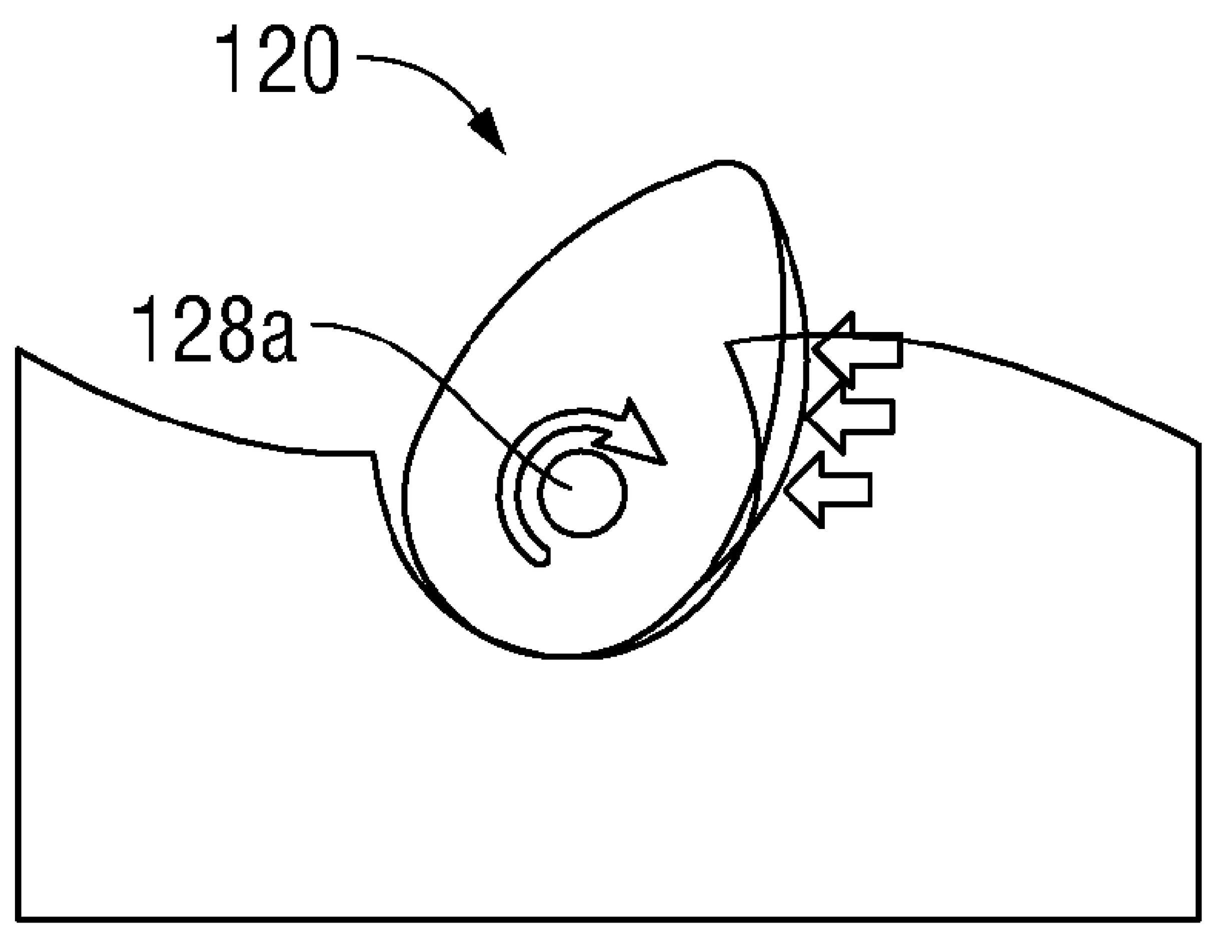



FIG. 5B

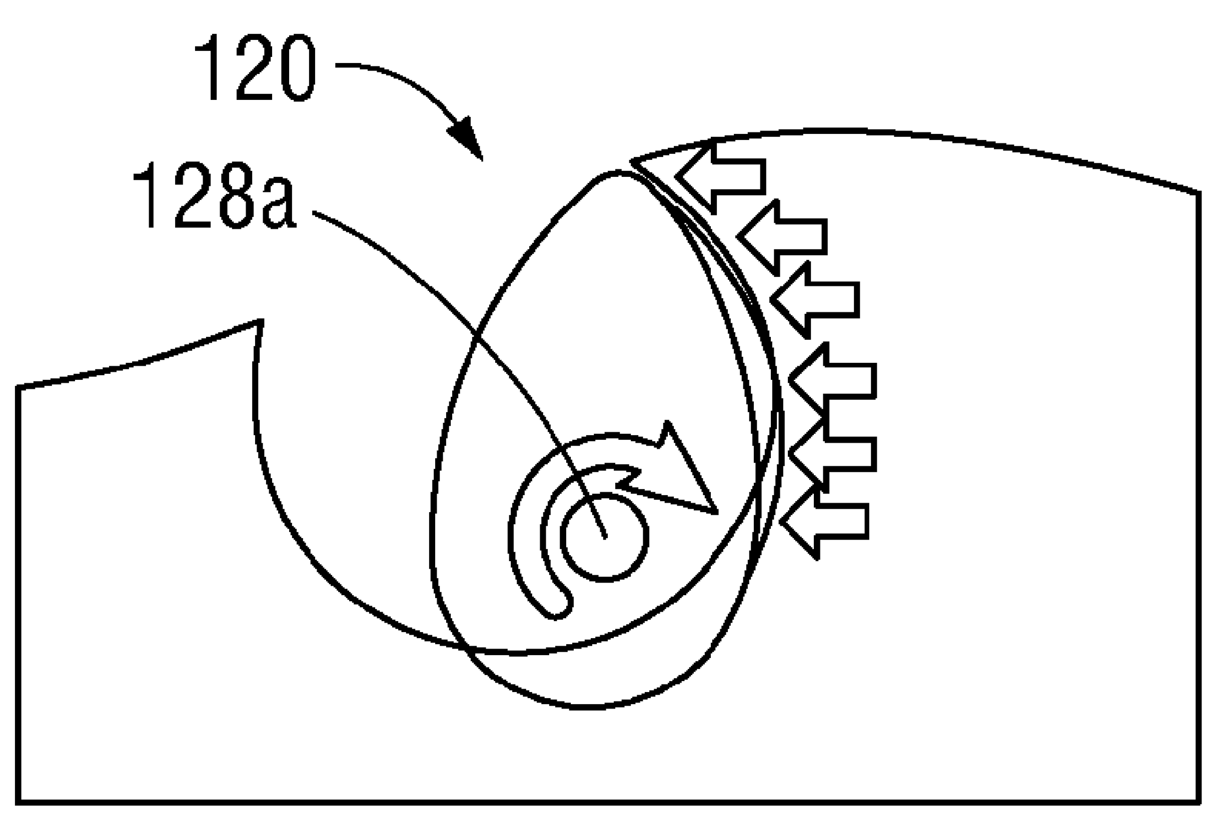



FIG. 5C

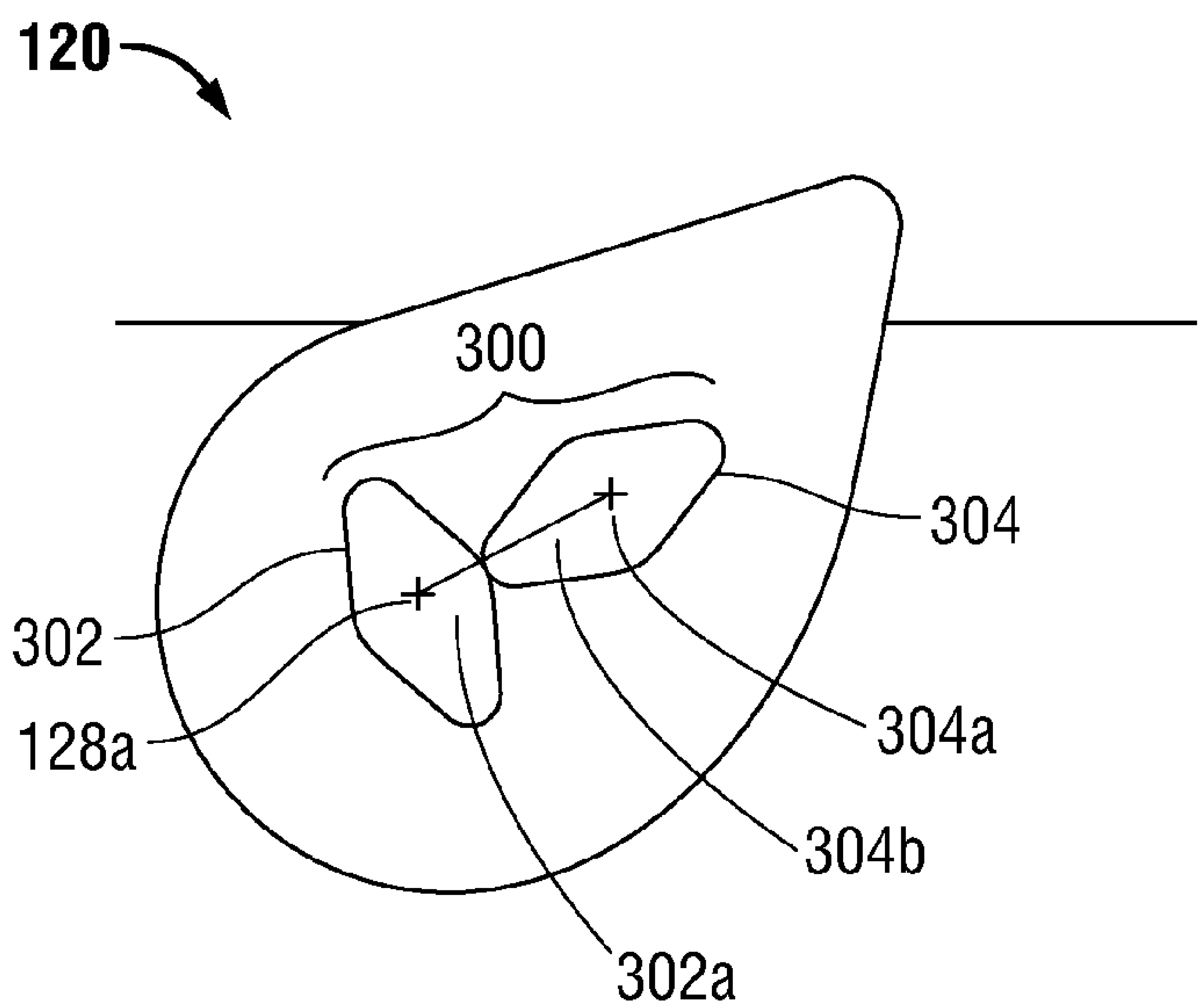



FIG. 6

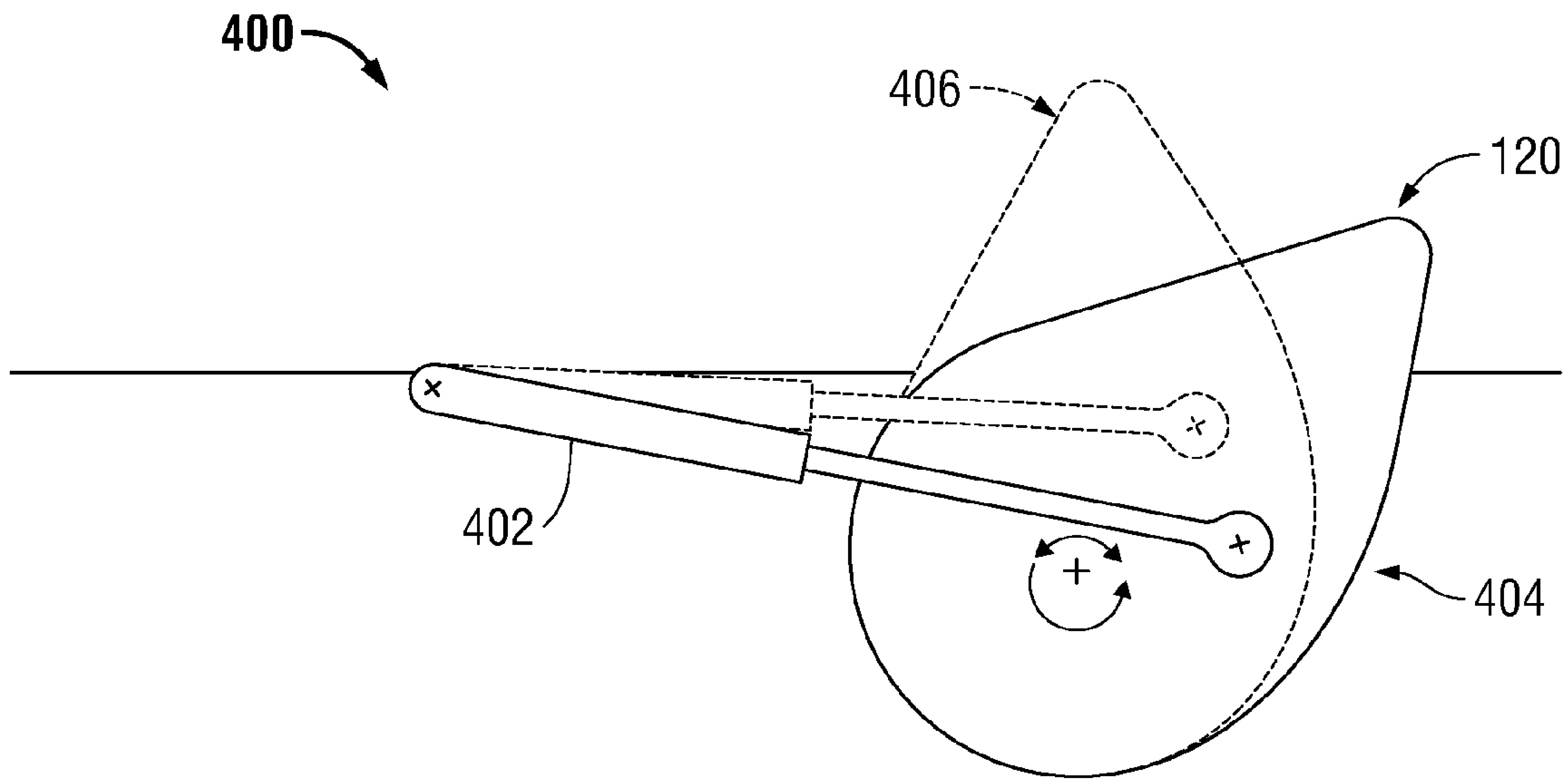



FIG. 7

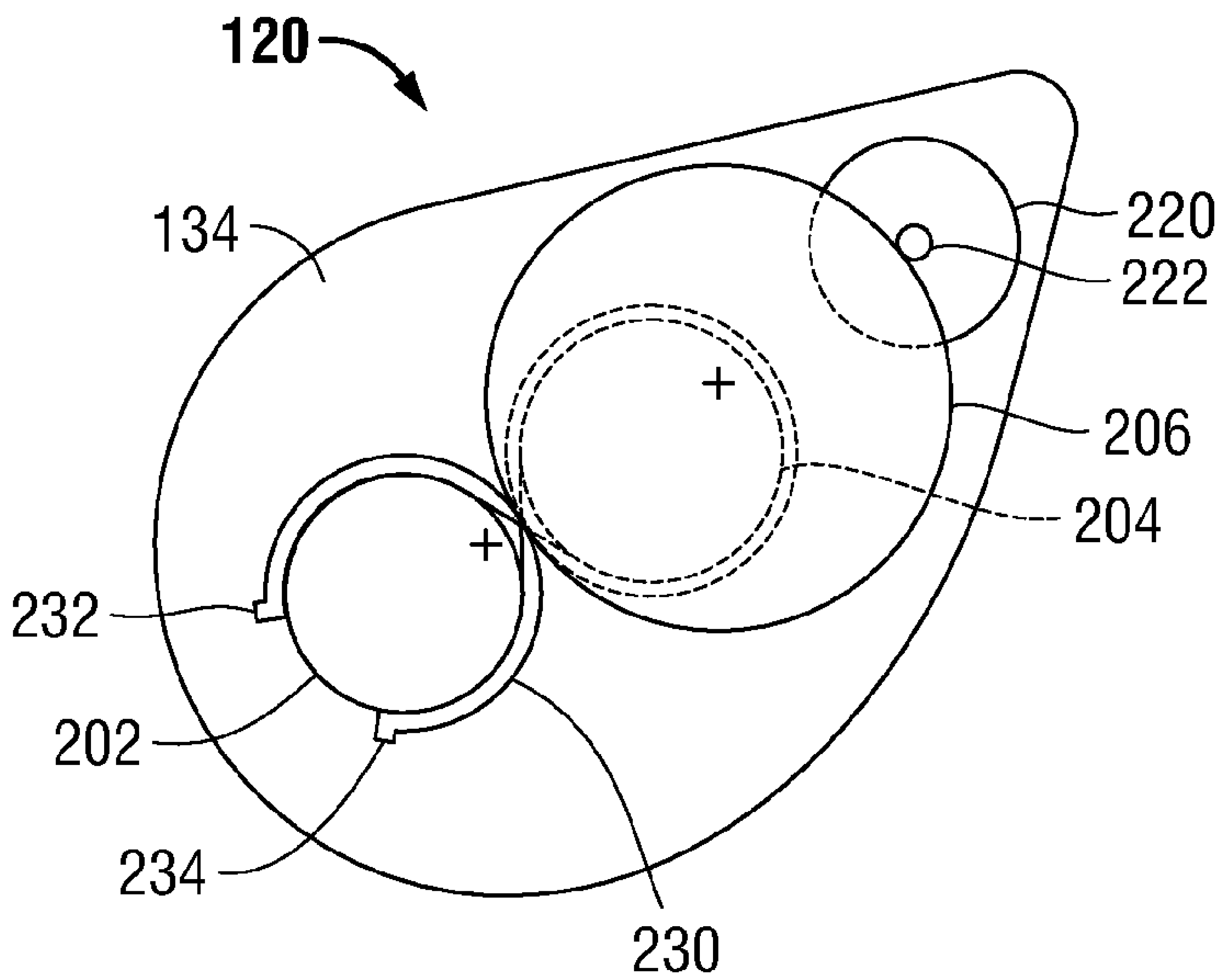



FIG. 8

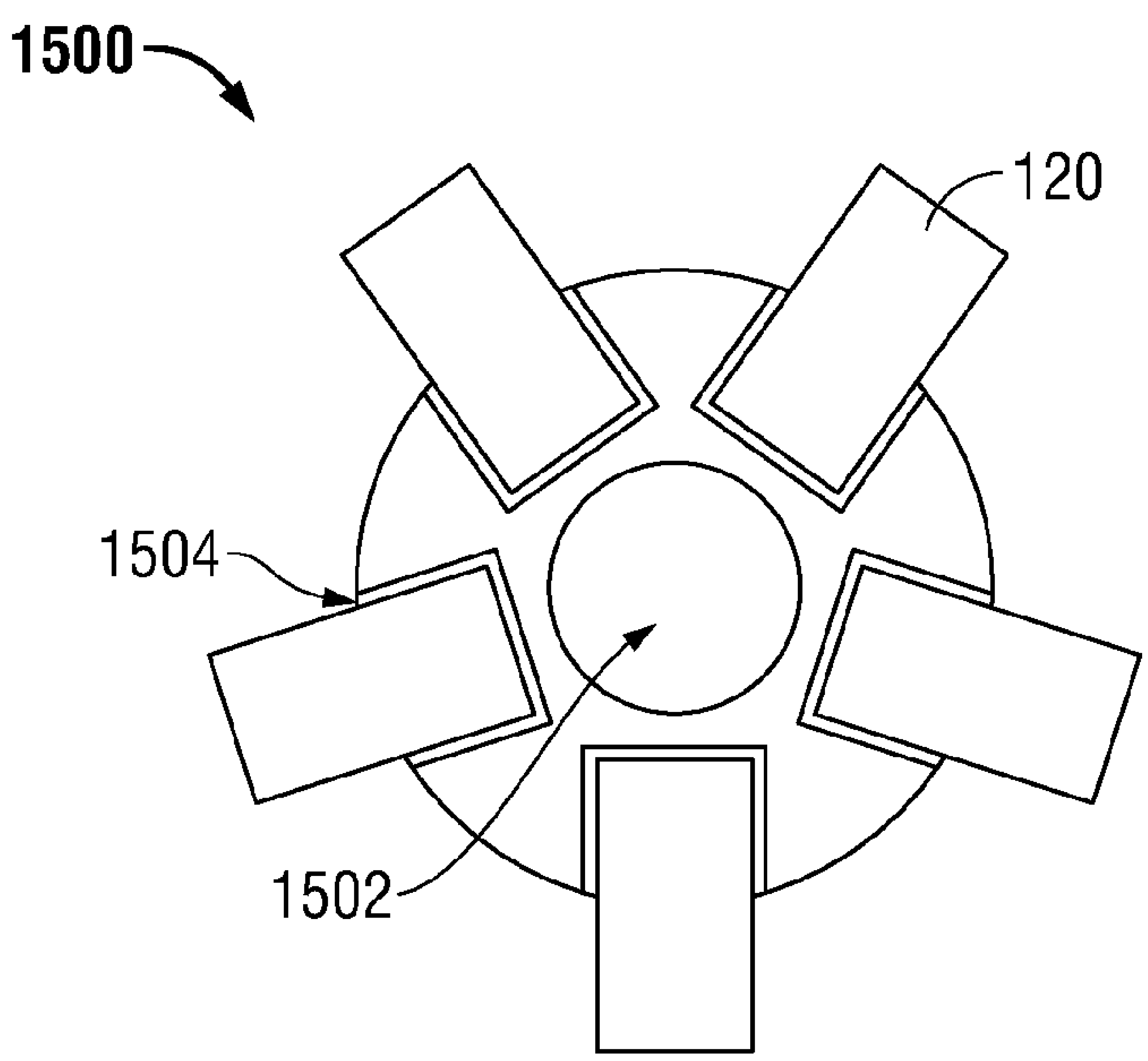



FIG. 9

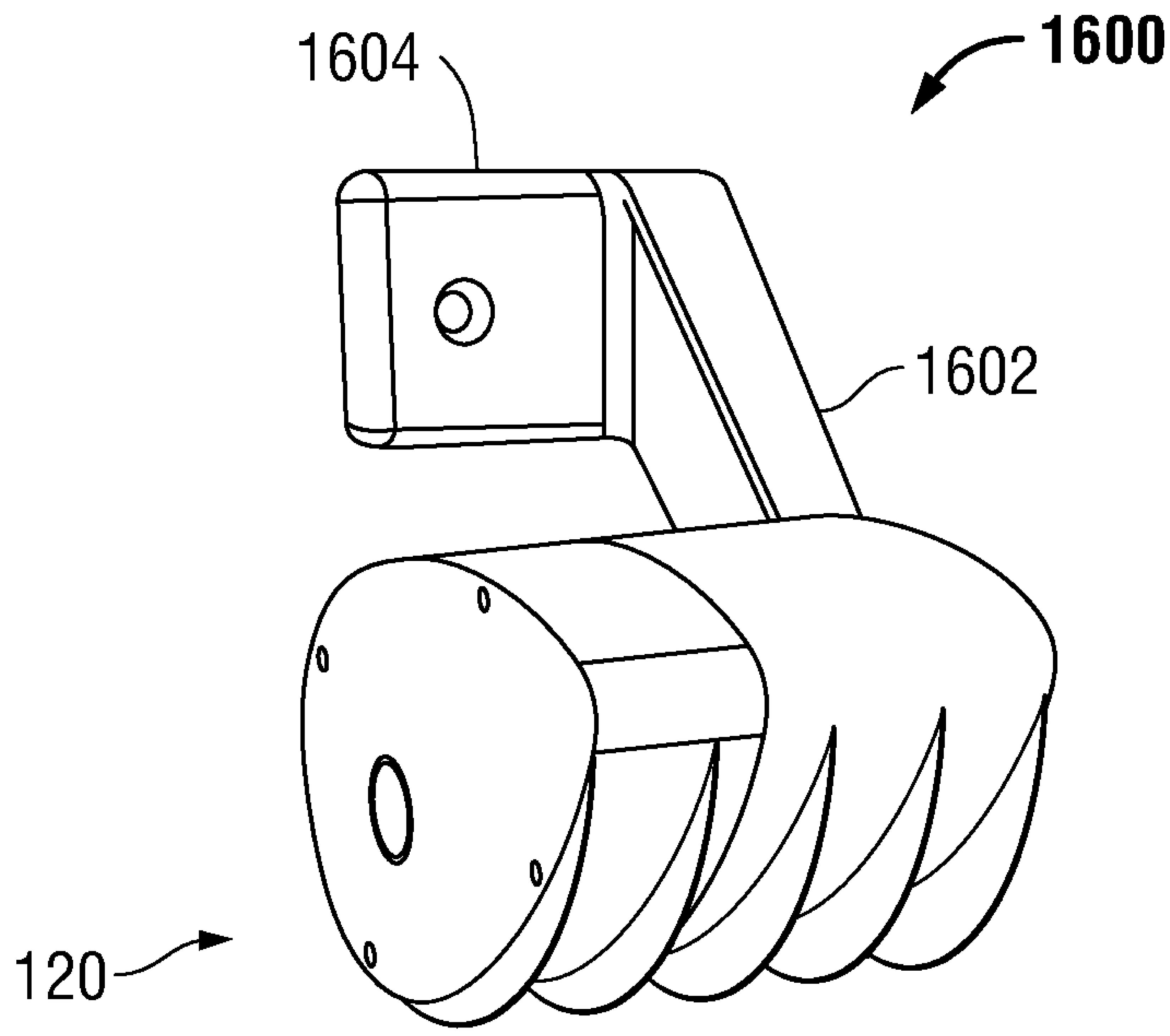



FIG. 10

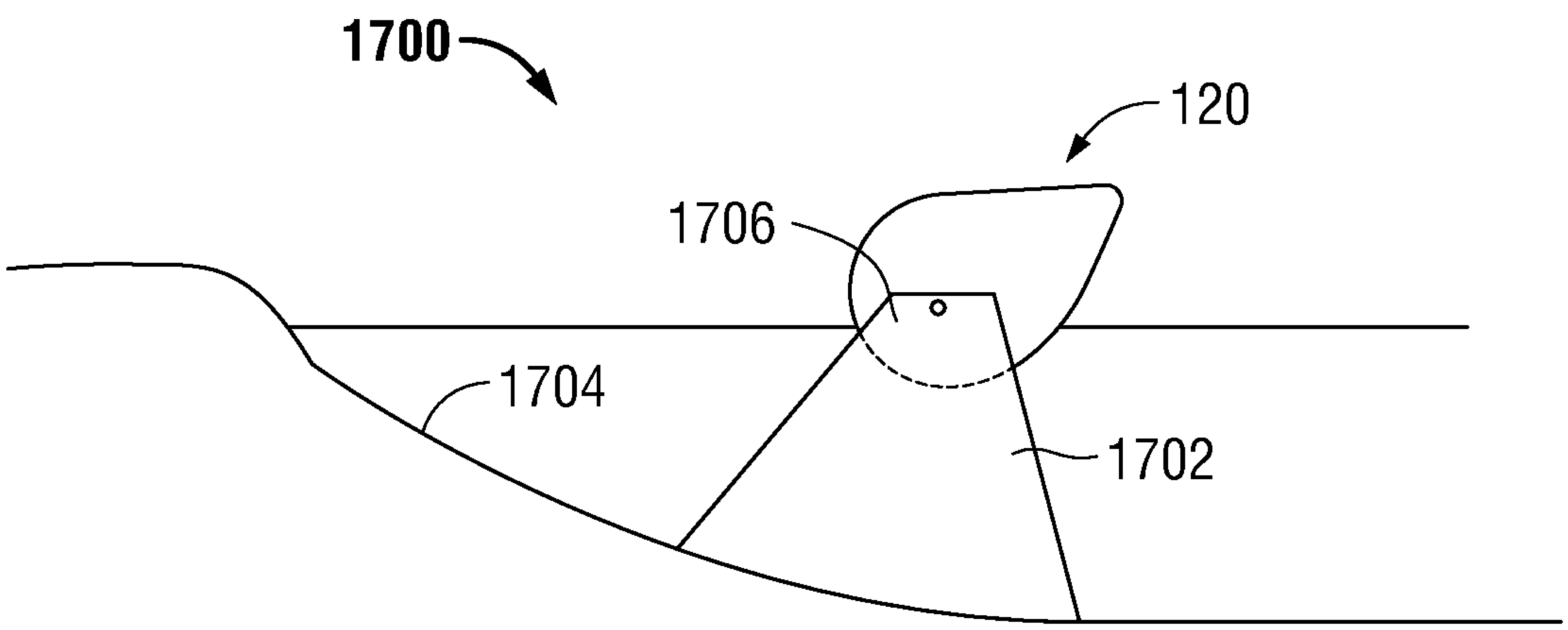



FIG. 11

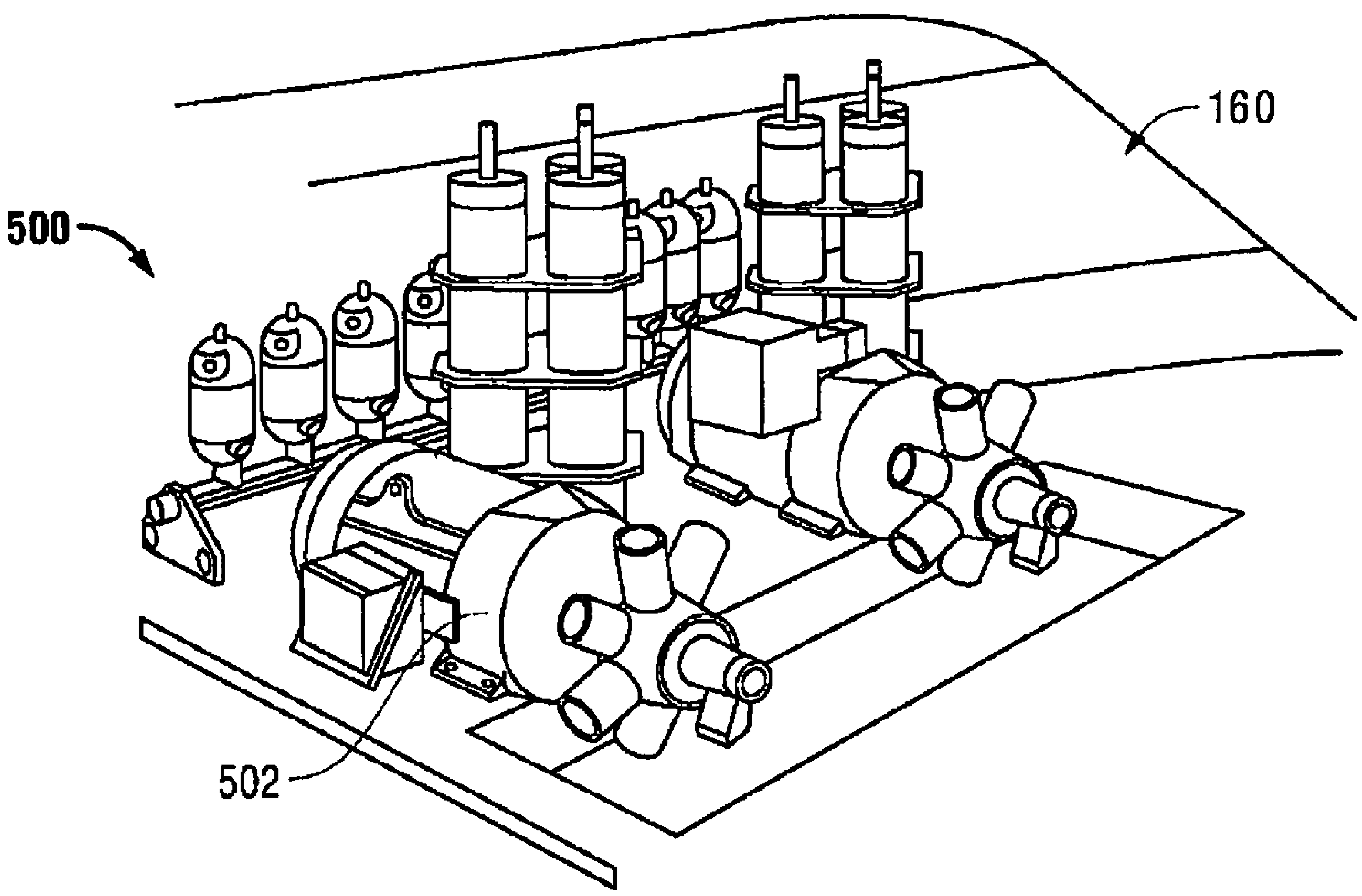



FIG. 12

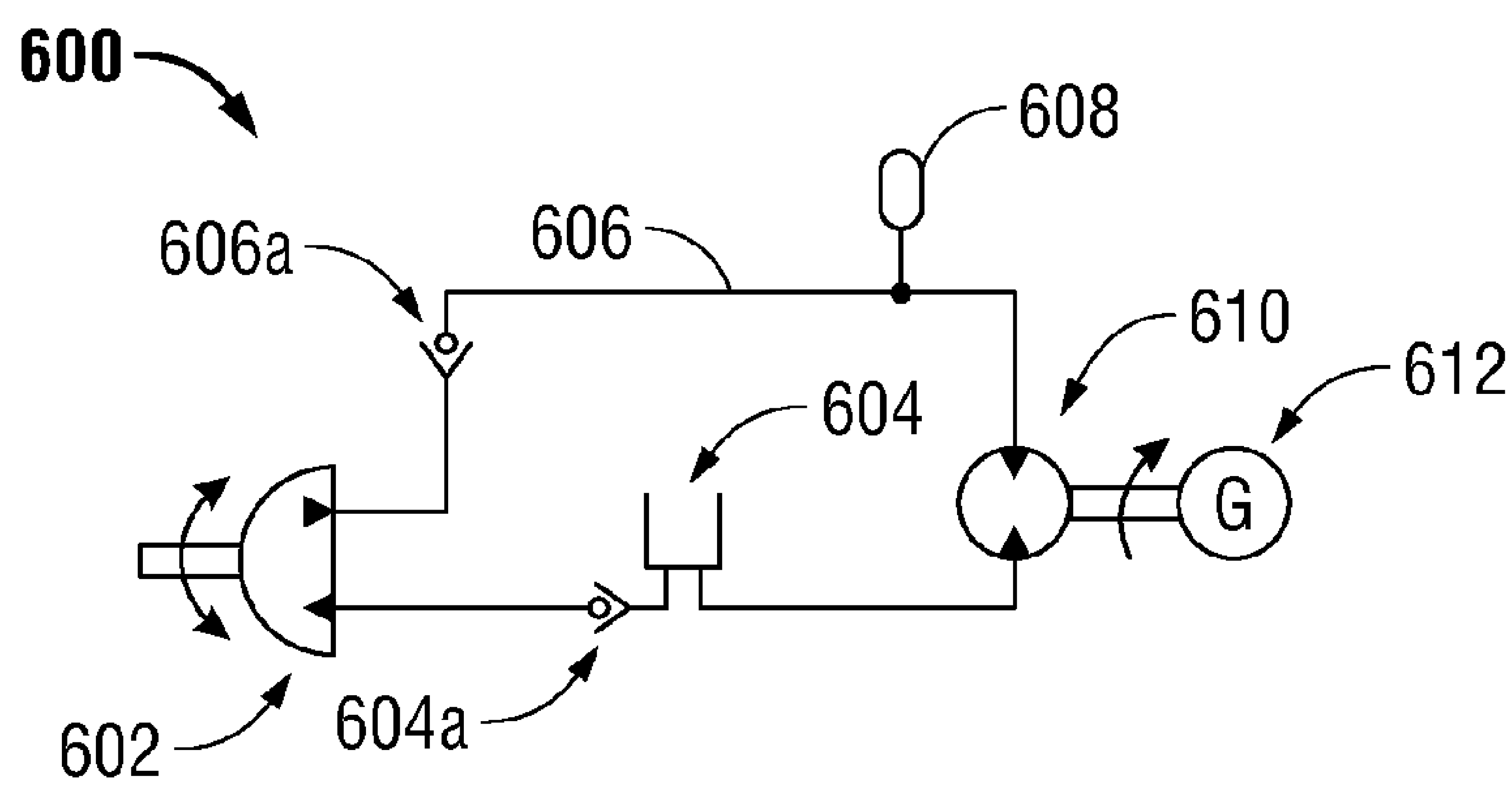



FIG. 13

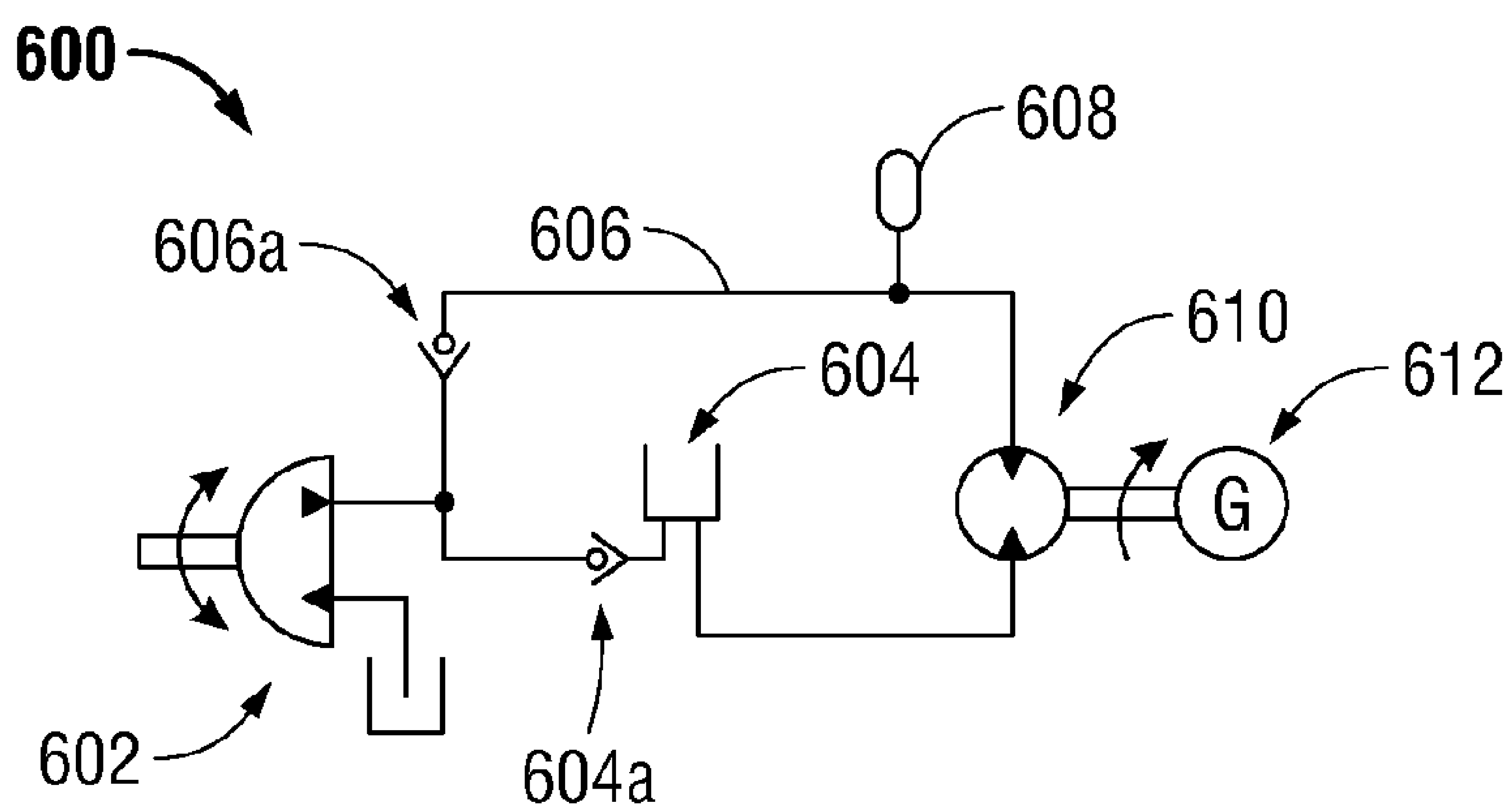



FIG. 13A

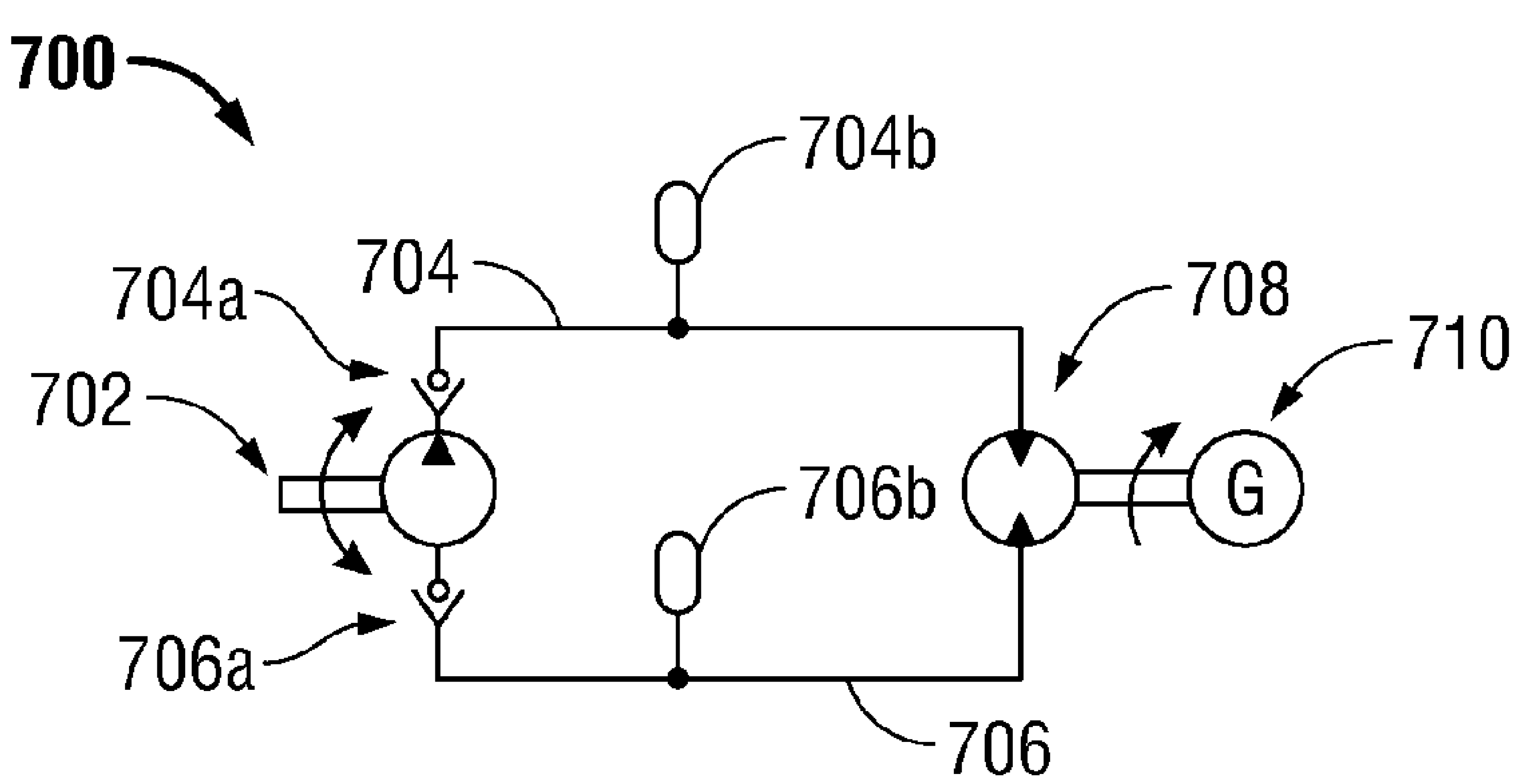



FIG. 14

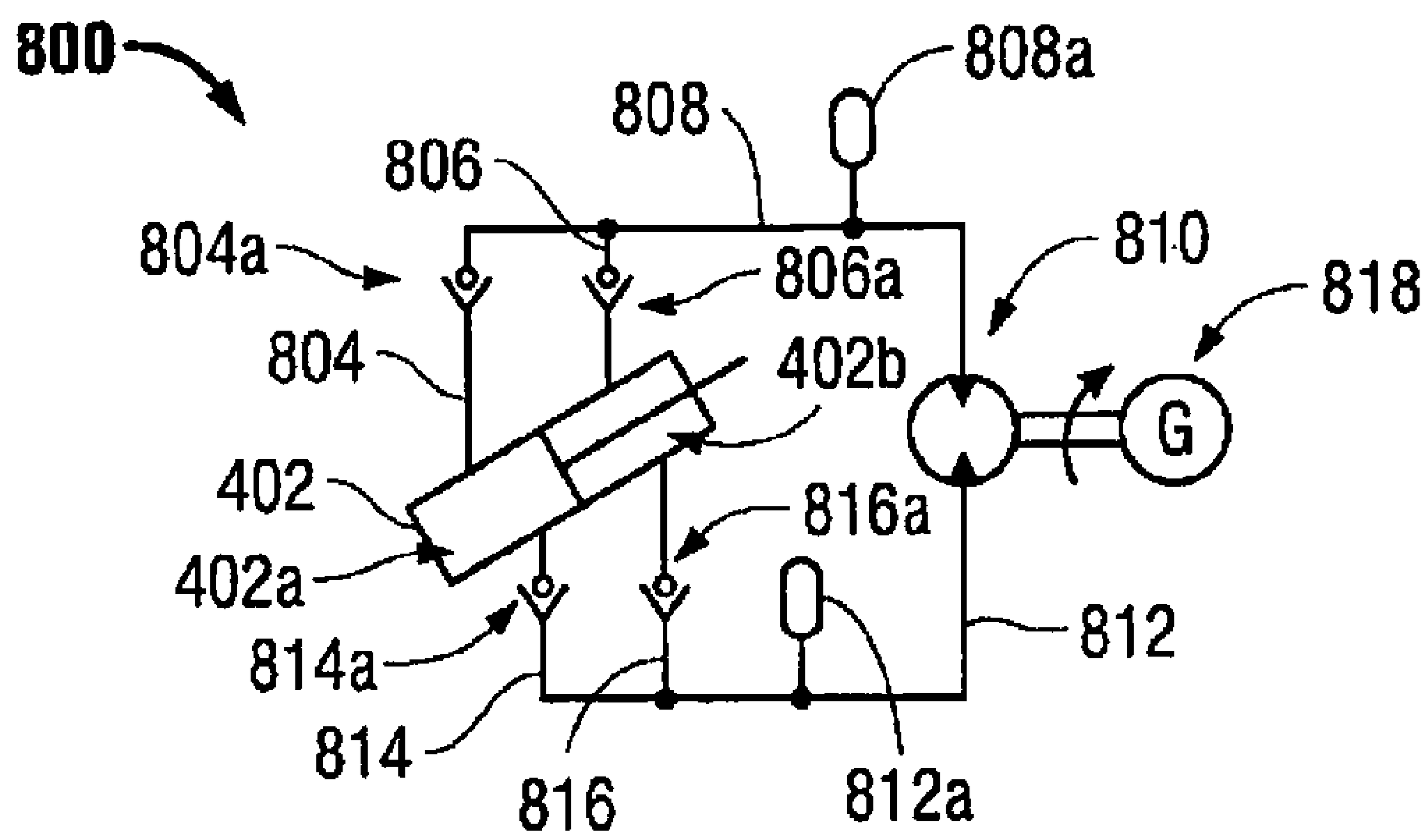



FIG. 15

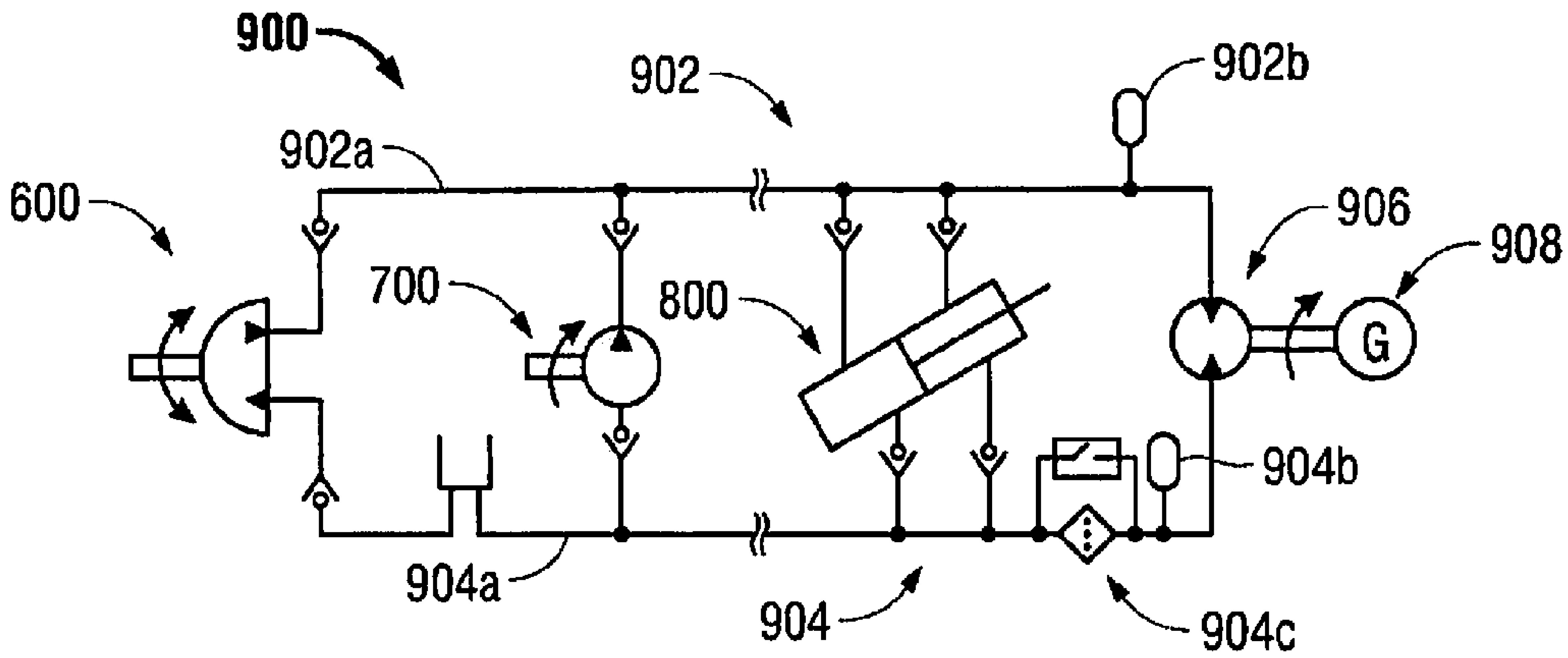



FIG. 16

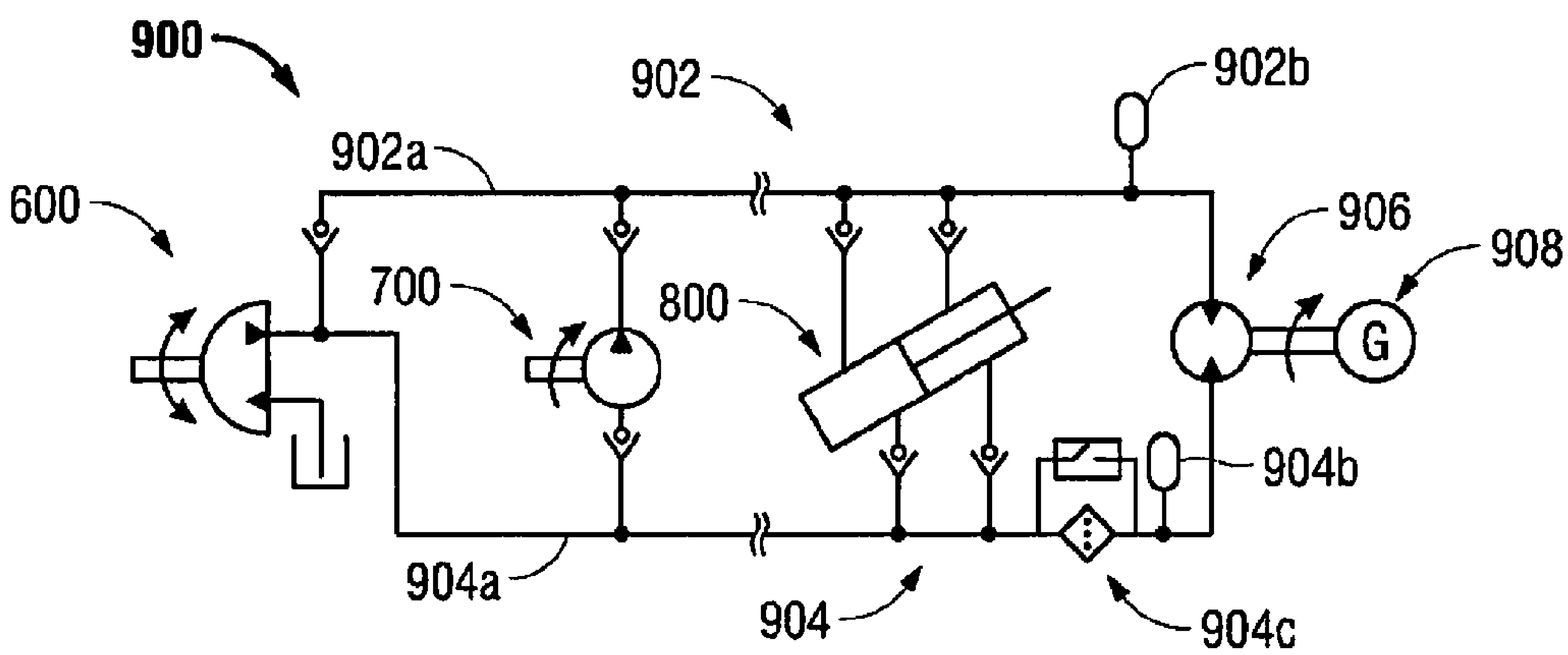



FIG. 16A

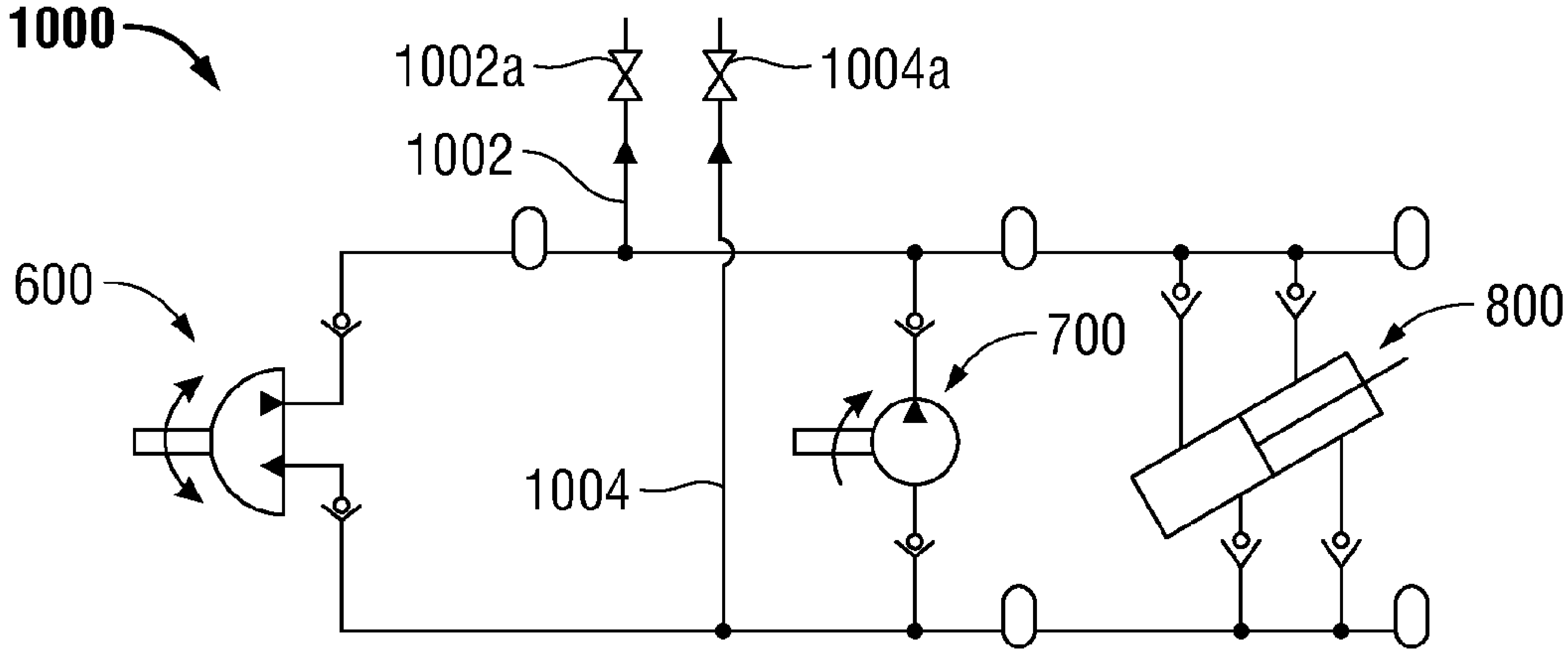
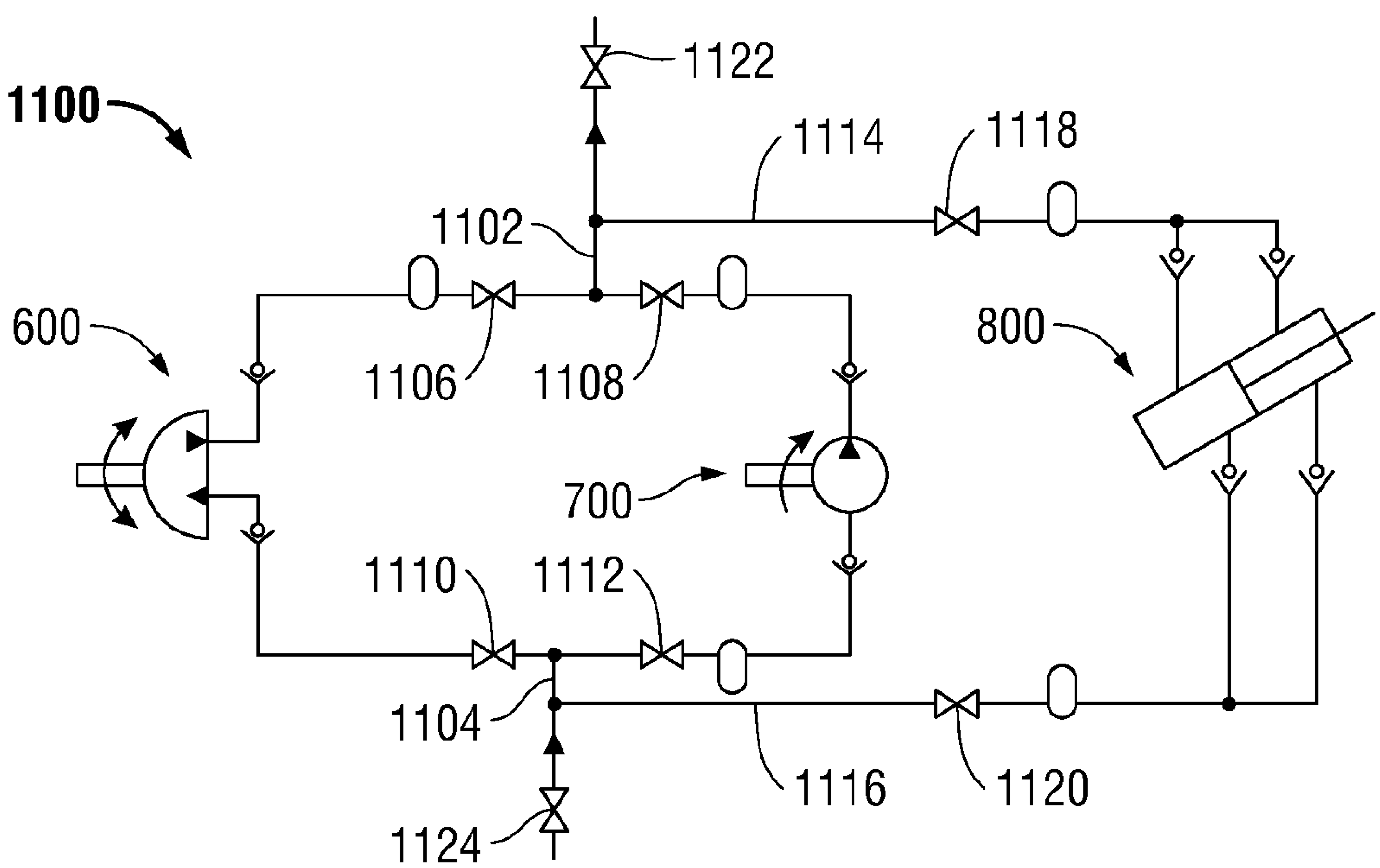

1000
1002a
1004a
1002
600
700
800
1004

FIG. 17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1110
1112
1104
1116
1120
1124

FIG. 18

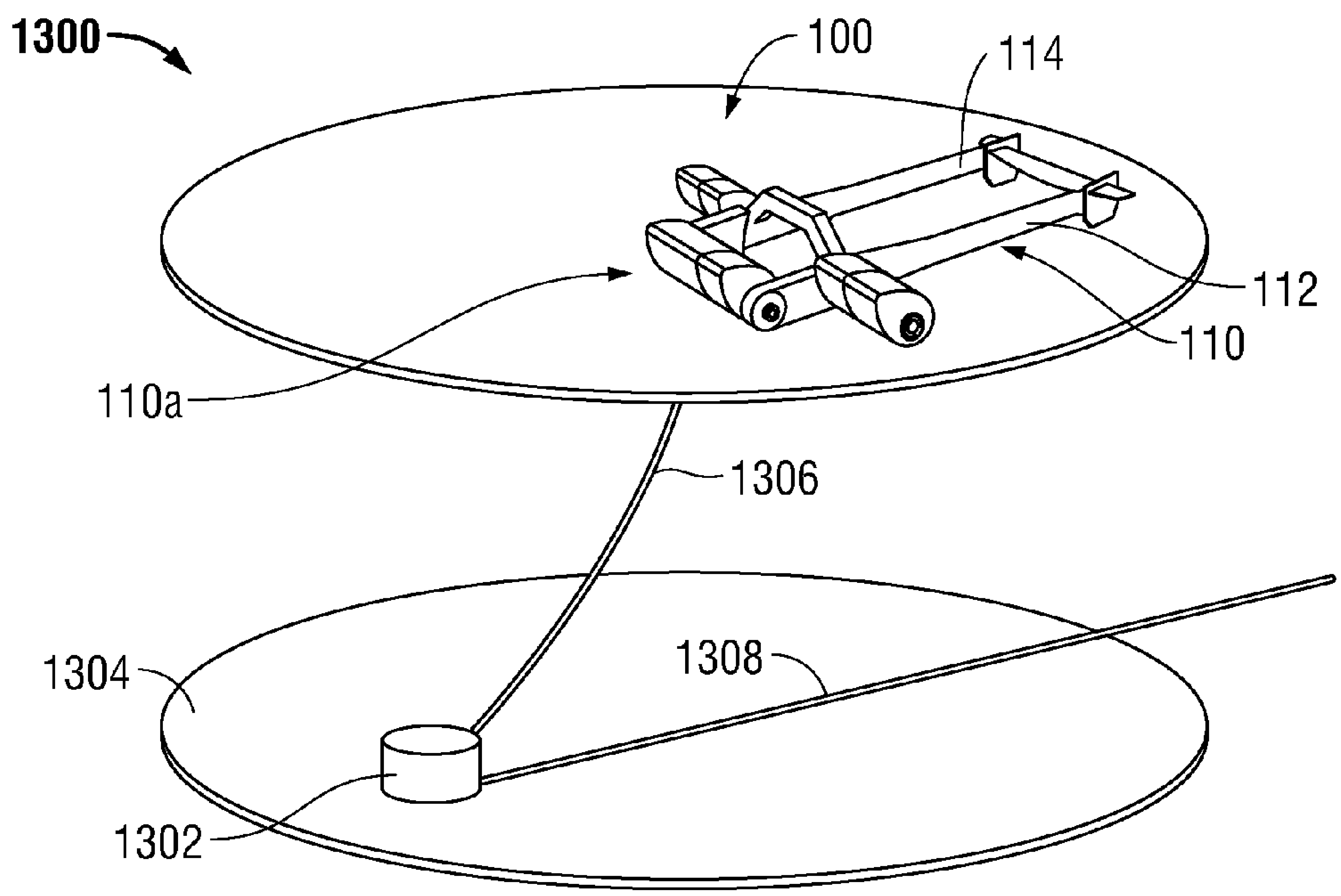



FIG. 19A

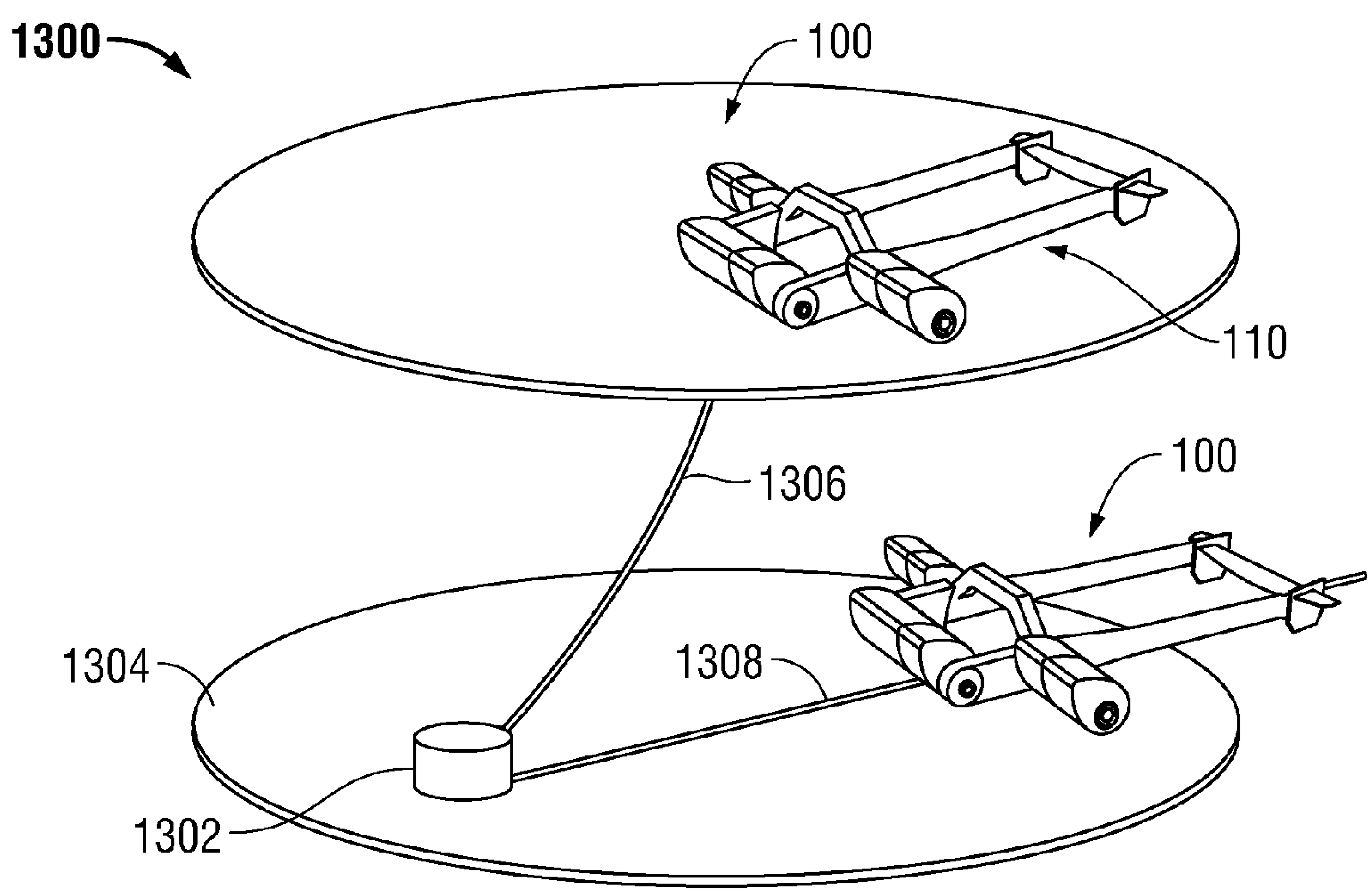
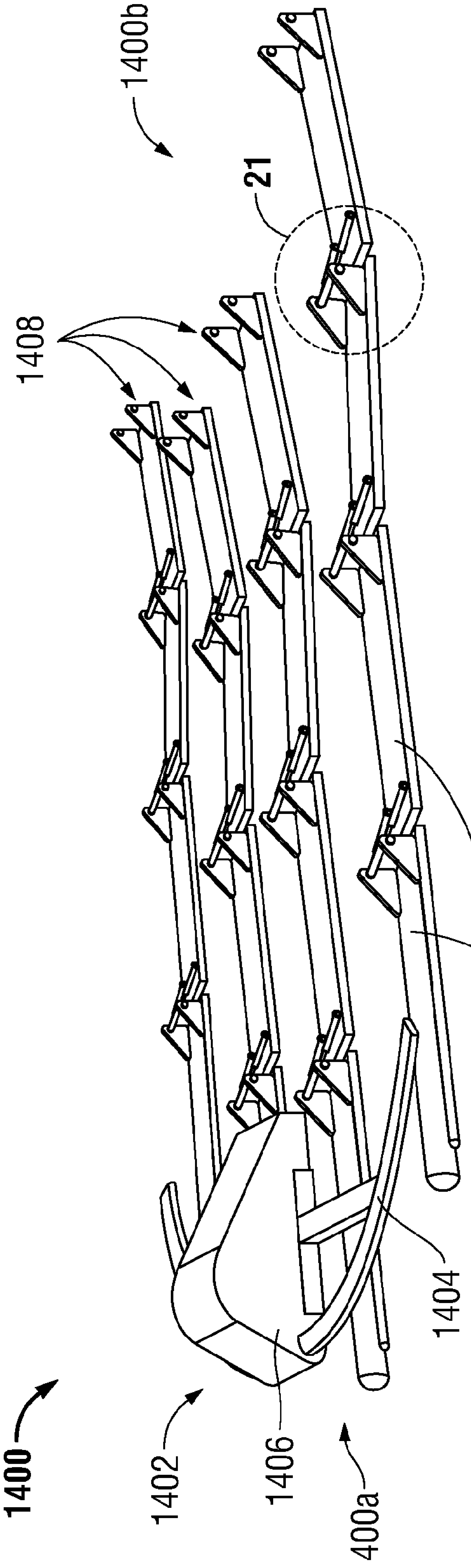



FIG. 19B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1410
1404
1400
1402
1406
1400a

FIG. 20

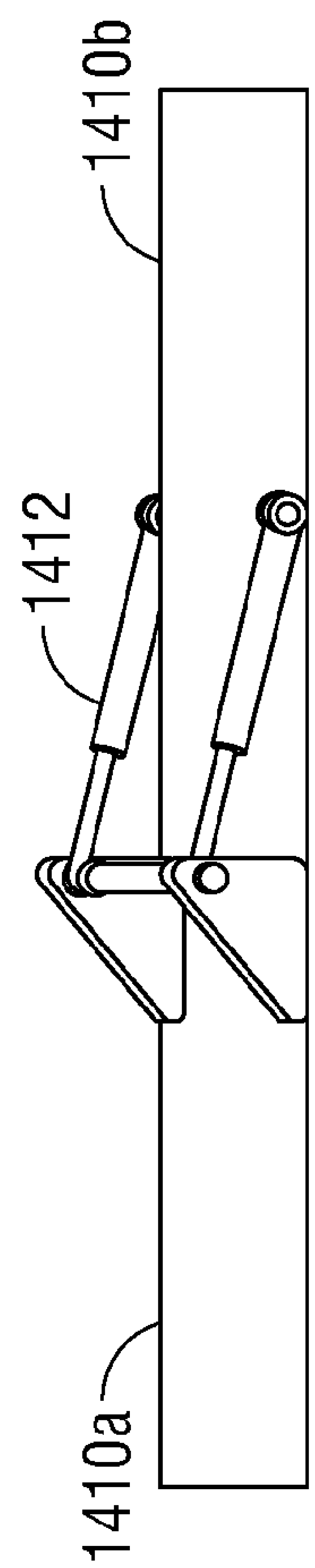
1410b
1412
1410a

FIG. 21

# WAVE ENERGY CONVERSION SYSTEM

## CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of, and priority to, U.S. Provisional Patent Application No. 61/977,371, filed on Apr. 9, 2014, U.S. Provisional Patent Application No. 61/988,637, filed on May 5, 2014, and U.S. Provisional Patent Application No. 62/060,795, filed on Oct. 7, 2014, the entire contents of each of which are incorporated herein by reference.

## BACKGROUND

Technical Field

The present disclosure relates to energy conversion devices and, more particularly, to systems for converting energy from the wave patterns of a body of water into electrical energy.

Description of Related Art

Significant effort has been expended on developing technologies able to utilize the earth's tremendous power. For centuries, devices such as windmills, watermills, hydro-turbines, geo-thermal heat generators, and solar energy panels have been developed and refined to capture and convert the earth's energy into electrical energy. However, even though over 70% of the earth's surface is covered by oceans, very little innovation has been developed capable of efficiently harnessing this vast power. It is estimated that ocean waves are capable of generating an energy flux between 10 kW and 80 kW per meter of coastline. Most importantly, this energy is generated on a nearly continuous basis, with little to no interruption as compared to solar or wind powered solutions. Accordingly, a need for an efficient, scalable, and cost efficient system for harnessing the power of the ocean's waves is needed.

## SUMMARY

A wave energy conversion system is provided in accordance with the present disclosure includes a pod, a multi-radius energy transmission mechanism, and an electrical generating device. The pod is rotatably supported by a platform structure and the multi-radius energy transmission mechanism is in mechanical communication with the pod. The multi-radius energy transmission mechanism is configured to transmit a variable torque over a range of motion. The electrical generating device is in mechanical communication with the multi-radius energy transmission mechanism.

The pod may be buoyant and may be configured to be rotated as a wave contacts a planar side surface disposed on a leading side of the pod. In certain aspects, the multi-radius energy transmission mechanism may include a drive gear rotatably supported on a drive-shaft extending through the center of rotation of the pod. The drive gear may be mechanically coupled to the pod. Alternatively, the multi-radius energy transmission mechanism may include a driven gear rotatably supported on a post fixedly secured to the platform structure. The drive gear and the driven gear may include an ellipsoid profile. The driven gear may be in mechanical communication with the drive gear.

In aspects, rotation of the pod may initiate rotation of the drive gear about driveshaft, thereby initiating a rotation of the driven gear about the post. The radius of the drive gear at a location adjacent the driven gear may increase as the drive gear rotates. The radius of the driven gear at a location adjacent the drive gear may decrease as the driven gear rotates, thereby transmitting a variable torque.

In certain aspects, the multi-radius energy transmission mechanism may include a spur gear rotatably supported on the post. The spur gear may be in mechanical communication with the driven gear and the electrical generating device.

In certain aspects, the electrical generating device may include a hydraulic circuit. The hydraulic circuit may include a hydraulic actuator in mechanical communication with the multi-radius energy transmission mechanism. The hydraulic actuator may be in hydraulic communication with a hydraulic motor. Actuation of the hydraulic actuator may cause the hydraulic motor to rotate, thereby causing an electrical generator in mechanical communication therewith to generate electrical energy.

In certain aspects, the drive gear and the driven gear may be rotatably supported at a location other than their geometric centers. The drive gear and the driven gear may be circular gears. The drive gear and the driven gear may be elliptical gears. The drive gear and the driven gear may be mechanically coupled by a belt. The electrical generating device may be a permanent magnet electrical generator. The electrical generating device may be an electromagnetic generator.

In some aspects, the wave energy conversion system may further include a wave measuring device fixedly secured to the platform structure. The wave measuring device may include a buoy partially disposed in the water. The buoy may be coupled to the propagating waves, thereby measuring the wave height and the period of the waves as they pass under the platform structure. The electromagnetic generator may vary its torque response based upon the measurements gathered by the wave measuring device.

In aspects, the hydraulic actuator may be a hydraulic rotary actuator, a hydraulic pump.

In some aspects, a plurality of pods may be rotatably supported on the platform structure.

In aspects, the wave energy conversion system may further include a hydraulic system, which may include a plurality of hydraulic circuits. Each of the plurality of hydraulic circuits may be mechanically coupled to a respective one of the plurality of pods. Each hydraulic circuit may contribute to the actuation of a hydraulic motor in mechanical communication with an electrical generator, thereby generating electrical energy.

In certain aspects, the multi-radius energy transmission mechanism may include a driven gear fixedly disposed on a drive-shaft extending through the center of rotation of the pod. Alternatively, the multi-radius energy transmission mechanism may include a driven gear rotatably supported on a post fixedly secured to an end surface defined on the pod.

In aspects, the wave energy conversion system may further include a ballasting system. The ballasting system may be configured to selectively submerge the wave energy system.

A further aspect of the disclosure is a method of converting wave energy into electrical energy is also provided in accordance with the present disclosure including providing a wave energy conversion system including a pod rotatably supported by a platform structure, a multi-radius energy transmission mechanism in mechanical communication with the pod, the multi-radius energy transmission mechanism configured to transmit a variable torque over a range of motion, and an electrical generating device in mechanical communication with the multi-radius energy transmission mechanism. The method further includes initiating rotation of the pod, thereby causing the multi-radius energy transmission mechanism to cause the electrical generating device to generate electricity.

In aspects, initiating rotation of the pod may include the multi-radius energy transmission mechanism imparting an increasing torque on the pod as the pod rotates from an initial position to a maximum position. Providing a wave energy conversion system may include the multi-radius transmission mechanism having a drive gear rotatably supported on the driveshaft and a driven gear rotatably supported on a post fixedly secured to the platform structure. Rotation of the pod may cause the drive gear to initiate rotation of the driven gear. Further, providing a wave energy conversion system may include the driven gear being in mechanical communication with the electrical generating device. Rotation of the pod may cause the electrical generating device to generate electricity.

In aspects, providing a wave energy conversion system may include the drive gear and driven gear having an elliptical profile. A radius of the drive gear may increase and a radius of the driven gear may decrease at a location adjacent to the interface of the drive gear and driven gear as the pod is rotated, thereby transmitting a variable torque.

## BRIEF DESCRIPTION OF THE DRAWINGS

Various aspects and features of the present disclosure are described hereinbelow with references to the drawings, wherein:

FIG. **1** is a perspective view of a system provided in accordance with the present disclosure capable of extracting energy from waves;

FIG. **1**A is a perspective view of another system provided in accordance with the present disclosure capable of extracting energy from waves;

FIG. **2** is a perspective view of a pod of the system of FIG. **1**;

FIG. **3** is a side view of the pod of FIG. **2**;

FIG. **4** is a side view of the pod of FIG. **2**, shown in a static position and illustrating a multi-radius energy transmission mechanism disposed thereon;

FIG. **4**A is a side view of the pod of FIG. **4**, shown in a maximum position;

FIG. **4**B is a side view of another embodiment of the multi-radius energy transmission mechanism of FIG. **4**;

FIG. **5**A is a side view of the pod of FIG. **2**, shown in a static position as a wave impacts the pod;

FIG. **5**B is a side view of the pod of FIG. **5**A, shown in an intermediate position as the wave causes the pod to rotate;

FIG. **5**C is a side view of the pod of FIG. **5**A, shown in a maximum position as the pod is further rotated by the wave;

FIG. **6** is a side view of the pod of FIG. **2**, illustrating another multi-radius energy transmission mechanism;

FIG. **7** is a side view of the pod of FIG. **2**, illustrating yet another multi-radius energy transmission mechanism;

FIG. **8** is a side view of the pod of FIG. **2**, illustrating still another multi-radius energy transmission mechanism;

FIG. **9** is a plan view of a platform structure including a plurality of pods rotatably supported thereon;

FIG. **10** is a perspective view of another platform structure including a pod rotatably supported thereon;

FIG. **11** is a side view of still another platform structure including a pod rotatably supported thereon;

FIG. **12** is a perspective view of the system of FIG. **12**, illustrating a head of the platform structure including a hydraulic system disposed therein;

FIG. **13** is a schematic view of a hydraulic circuit provided in accordance with the present disclosure;

FIG. **13**A is a schematic view of an alternate embodiment of the hydraulic circuit of FIG. **13**;

FIG. **14** is schematic view of another hydraulic circuit provided in accordance with the present disclosure;

FIG. **15** is schematic view of still another hydraulic circuit provided in accordance with the present disclosure;

FIG. **16** is a schematic view of a hydraulic system provided in accordance with the present disclosure, including the hydraulic circuits of FIGS. **13**, **14**, and **15**;

FIG. **16**A is a schematic view of an alternate embodiment of the hydraulic system of FIG. **16**;

FIG. **17** is a schematic view of another hydraulic system provided in accordance with the present disclosure, including the hydraulic circuits of FIGS. **13**, **14**, and **15**;

FIG. **18** is a schematic view of yet another hydraulic system provided in accordance with the present disclosure, including the hydraulic circuits of FIGS. **13**, **14**, and **15**;

FIG. **19**A is a perspective view of the system of FIG. **1**, shown in a floating position;

FIG. **19**B is a perspective view of the system of FIG. **19**A, shown in a submerged position;

FIG. **20** is a perspective view of yet another system provided in accordance with the present disclosure capable of extracting energy from waves; and

FIG. **21** is an enlarged view of the indicated area of detail of FIG. **20**.

## DETAILED DESCRIPTION

Systems for converting energy from the wave patterns of a body of water into electrical energy are provided in accordance with the present disclosure and described in detailed below. However, these detailed embodiments are merely examples of the present disclosure, which may be embodied in various forms.

With reference to FIG. **1**, a system provided in accordance with the present disclosure and configured for converting energy from the wave patterns of a body of water into electrical energy is shown generally identified by reference numeral **100**. System **100** generally includes a platform structure **110** which is configured to be partially submerged within the ocean.

Platform structure **110** includes a plurality of elongate members **112** and **114** arranged in a parallel configuration. A stabilizing beam **116** is interposed between each of elongate members **112**, **114** at a trailing or leeward end **110*b*** and a connective beam **118** is interposed between each of elongate members **112**, **114** at a leading or windward end **110*a***. Stabilizing beam **116** and connective beam **118** cooperate to provide transverse stability to platform structure **110** and maintain each of elongate members **112**, **114** in a parallel configuration. Stabilizing beam **116** and connective beam **118** may be rigidly secured to each of elongate members **112**, **114** using any suitable means, such as welding, adhesives, bolted connection, rivets, or the like.

As best illustrated in FIG. **1**, elongate members **112**, **114** include similar profiles, and therefore only one will be described herein in the interest of brevity. Elongate member **112** includes a generally oar shaped profile in order to further increase the stability of platform structure **110**. In this manner, the windward end **112*a*** of elongate member **112** includes an oval-shaped cross section **112*b***, reminiscent of that of the paddle portion of the oar. The oval-shaped cross section **112**$b$ transitions to a circular cross-section **112**$e$ in a leeward direction, although other suitable cross sections are also contemplated, such as square, octagonal, or the like. The circular cross section **112**$e$ includes an outer diameter that is less than that of oval-shaped cross section **112**$b$ and is reminiscent of the shank portion of an oar. A fin **112**$g$ is disposed on the leeward end **112**$f$ of elongate member **112** and extends in a leeward direction therefrom. Fin **112**$g$ includes a generally planar profile and includes a narrow cross section in a direction transverse to elongate body **112**. Fin **112**$g$ includes an overall height greater than that of the outer diameter of circular cross section **112**$e$ such that a greater portion of fin **112**$g$ is submerged within the water than the remaining portions of platform structure **110**. In this manner, the increased surface area of fin **112**$g$ submerged within the water provides a self-aligning capability that aligns platform structure **110** with the direction of wave propagation.

Referring now to FIGS. **2-8**, an energy removing member or pod provided in accordance with the present disclosure is shown generally identified by reference numeral **120**. As best illustrated in FIG. **3**, pod **120** includes a generally tear drop or egg shaped profile; however, other profiles are also contemplated as it has been found that the shape of pod **120** can significantly impact the energy removing capability (i.e., the efficiency) of the system. As best illustrated in FIG. **3**, pod **120** includes a pair of planar side surfaces **122**, **124** disposed in spaced relation to each other and oriented such that an upper end of each of planar side surfaces **122**, **124** intersect to form an apex **126**. Although generally shown as having an arcuate profile, apex **126** may include any suitable profile such as pointed, planar, or the like. Planar side surface **122** forms an angle β with respect to a vertical axis "V" of approximately 15 degrees, although other angles are also contemplated. Although generally shown as being disposed in a mirrored fashion, i.e., planar side surfaces **122**, **124** form an equal angle with respect to an axis defined through apex **126**, it is contemplated that planar side surface **122** may diverge at a greater angle than planar side surface **124**, or vice versa.

Planar side surface **122** is disposed on a leading or windward side **120**$a$ of pod **120** and transitions into a circular or arcuate profile **128** having a decreasing radius and extending towards and eventually joining planar side surface **124** disposed on a trailing or leeward side **120**$b$ of pod **120**. In this manner, the length of planar side surface **122** is shorter than that of planar side surface **124**. As best illustrated in FIG. **3**, the center of the initial radius of arcuate profile **128** is located at point **128**$a$ and the final radius of arcuate profile **128** is located at point **128**$b$, located a distance "D" above point **128**$a$ that is ½ the initial radius of arcuate profile **128**. This configuration provides a centroid or center of gravity **130** that is below the center of rotation of pod **120**, which is located at point **128**$a$, while also providing a center of buoyancy **133** that is above the center of rotation **128**$a$ of pod **120**. In combination, the geometry of the center of rotation **128**$a$, center of gravity **130**, and center of buoyancy **133** cause pod **120** to statically float in the water "W" such that planar side surface **122** intersects the water's surface at an angle of approximately 75 degrees (i.e., 15 degrees from vertical). It is contemplated, however, that the various geometries discussed above may be altered, depending on the materials used to construct pod **120**, the mechanical elements disposed within pod **120**, and other considerations that impact the mass, buoyancy, and the location of center of gravity of pod **120**.

FIG. **4** illustrates pod **120** in a first, static, position including a multi-radius energy transmission mechanism or transmission **200** capable of transmitting variable torque over a range of motion. The specific geometry of the components of transmission **200** enables pod **120** to efficiently extract energy from the waves. Scientific testing has revealed that the energy contained by a wave depends on the period between each crest of a wave and the height of each wave. A mathematical formula illustrating this relationship is: $P=\rho\cdot g^2/64\cdot\pi\cdot H_{m0}{}^2\cdot T_e$; where P is the wave energy flux per unit of wave-crest length, ρ is the density of the water; g is the gravitational constant, $H_{m0}$ is the significant wave height, and $T_e$ is the wave energy period. Thus, effective coupling of the pod **120** to the waves involves the angle of pod **120** in relation to the waves, the significant wave height, and the wave energy period.

When pod **120** is in a first, static, position (FIGS. **4** and **5**A), the waves impart a small amount of force upon pod **120**, thereby imparting a proportionally small amount of torque about point **128**$a$. Therefore, the resistance against rotation about point **128**$a$ provided by transmission **200** must be low in order to permit pod **120** to rotate about point **128**$a$ and thereby generate energy. As pod **120** is caused to further rotate (FIG. **5**B), the amount of force imparted by the waves increases with the amount of surface area of the windward side **120**$a$ of pod **120** that is exposed, thereby increasing the amount of torque generated about point **128**$a$ until pod **120** reaches a maximum angle of rotation (FIGS. **4**A and **5**C) at which point the torque generated is at its maximum. Therefore, as pod **120** is further rotated about point **128**$a$ from its static position, the resistance against rotation about point **128**$a$ provided by transmission **200** must also increase. Thus, the greater the wave height and the longer the period of the wave energy, the further pod **120** will rotate, and thus the greater the amount of counter torque will be required. As will be discussed below, transmission **200** provides a variable torque response as pod **120** is caused to rotate about point **128**$a$.

Referring no to FIG. **2**, pod **120** includes a side cover or transmission cover **132** releasably secured to an end surface **134** (FIG. **3**) defined by the perimeter of pod **120** (i.e., planar side surfaces **122**, **124**, apex **126**, and arcuate profile **128**, as illustrated in FIG. **3**). Side cover **132** is releasably secured to end surface **134** using any suitable means, such as bolts, latches, quick release fasteners, or the like. Although generally shown as having a profile complimentary to that of pod **120**, it is contemplated that side cover **132** may include any profile necessary to cover transmission **200** and shield transmission **200** from water or other elements. It is contemplated that side cover **132** may provide a water-tight seal against end surface **134** in order to inhibit water from contacting transmission **200**.

A plurality of fins **136** are fixedly secured to the windward side **120**$a$ of pod **120** extending along planar side surface **124** and arcuate profile **128**. Fins **136** increase the efficiency of pod **120** by capturing wave energy travelling at an oblique angle relative to the center of rotation **128**$a$ of pod **120**.

As illustrated in FIG. **4**, transmission **200** includes a drive gear **202** fixedly disposed on a driveshaft (not shown) extending through the center of rotation **128**$a$ of pod **120**, such that pod **120** is rotatably supported thereon. Drive gear **202** may be fixedly secured to the driveshaft using any suitable means, such as splines, friction fit, adhesives, or the like. The driveshaft is fixedly secured platform structure **110** and extends through pod **120** and extends past end surface **134**. Drive gear **202** is secured to the driveshaft at a point other than the geometric center of drive gear **202** such that drive gear **202** remains stationary as pod **120** rotates about the driveshaft.

An intermediate or driven gear **204** is rotatably supported on a post or spindle (not shown) that is fixedly disposed on end surface **134** in a cantilever fashion, although it is contemplated that the post may be supported on a first end by end surface **134** and on a second end by side cover **132** (FIG. **2**). Driven gear **204** is rotatably supported on the post by any suitable means, such as bearings, bushings, or the like. Alternatively, it is contemplated that the post may be rotatably supported by end surface **134** and may include torque transferring features (not shown), such as a plurality of splines or the like, that interface with complementary torque transmitting features disposed on driven gear **204**. As can be appreciated, driven gear may alternatively be fixedly secured to the post using friction fit, press fit, or other suitable means capable of transmitting torque from the post to driven gear **204**. Driven gear **204** is disposed on the post at a location **204***a* other than its geometric center such that the driven gear **204** rotates about the post in an eccentric manner as driven gear **204** is caused to be rotated by drive gear **202**. In this manner, driven gear **204** rotates about drive gear **202** in a planetary fashion. The eccentric rotation of driven gear **204**, coupled with the eccentric mounting of drive gear **202**, ensures that each of driven gear **204** and drive gear **202** remain in mechanical communication as pod **120** is caused to be rotated by wave energy. In this manner, the relative centers of rotation of drive gear **202** and driven gear **204** remain constant as pod **120** rotates about center of rotation **128***a* while the torque transfer between drive gear **202** and driven gear **204** varies with continued rotation of pod **120**.

As illustrated in FIG. **4**, in a first, static position, drive gear **202** and driven gear **204** are disposed about their respective points of rotation, **128***a*, **204***a*, such that the radius between point **128***a* and the interface between drive gear **202** and driven gear **204** is a minimum value **202***a*, and the radius between location **204***a* and the interface between drive gear **202** and driven gear **204** is a complimentary maximum value **204***b*. As pod **120** is caused to be rotated by the waves, the radius between point **128***a* and the interface between drive gear **202** and driven gear **204** increases, whereas the radius between location **204***a* and the interface between drive gear **202** and driven gear **204** decreases, thereby providing a variable torque response against the torque generated by the waves through the counterclockwise motion of the pod **120** (i.e., the resistance to rotation increases as pod **120** is rotated counterclockwise). Ultimately, as illustrated in FIGS. **4**A and **5**C, when pod **120** is caused to rotate to a maximum position (i.e., the position generating maximum torque), drive gear includes a maximum radius **202***b* and driven gear includes a complimentary minimum radius **204***c*. As can be appreciated, the radius of each of drive gear **202** and driven gear **204** is continuously variable through the rotation of pod **120**, thereby maintaining mechanical communication therebetween (i.e., the gear teeth (not shown) of each maintain a proper mesh throughout the range of rotation of pod **120**).

Referring again to FIG. **4**, a spur gear **206** is rotatably disposed on the post (i.e., the same post on which driven gear is disposed) such that spur gear **206** rotates about its geometric center. Spur gear **206** is fixedly secured to driven gear **204** by any suitable means (i.e., bolted connection, nested configuration using friction fit, press fit, cogs, etc.), such that spur gear **206** rotates in unison with driven gear **204** (i.e., the torque from driven gear **204** is imparted on spur gear **206**). In the instance where driven gear **204** is fixedly secured to the post, spur gear **206** includes complimentary torque transmitting features to those of the post. In this manner, similarly to above, spur gear **206** and driven gear **204** rotate in unison. It is contemplated that spur gear **206** may be mechanically coupled to driven gear **204** using a one way clutch or other suitable device such as a ratcheting mechanism. In this manner, spur gear **206** is only driven by driven gear **204** in a first direction (i.e., as pod **120** is caused to rotate from an initial position to its maximum position), and is decoupled from driven gear in a second direction (i.e., as pod **120** returns to its initial position).

An electrical generating device or generator **220** is disposed within end surface **134** of pod **120**. Generating device **220** may be any suitable generating device such as a permanent magnet electrical generator, electromagnetic generator, hydraulic rotary actuator, hydraulic pump, or the like. Generator **220** includes a pinion gear **222** in mechanical cooperation with spur gear **206**, such that as spur gear **206** is rotated, pinion gear **222** is likewise rotated, thereby generating electrical energy. It is contemplated that driven gear **204**, and therefore, spur gear **206**, may include a one way clutch, or one way clutch bearing (not shown) disposed thereon. In this manner, the generating device is only driven when pod **120** is caused to be rotated from its initial position (FIG. **4**) to its final position (FIG. **4**A). As pod **120** returns to its initial position, the one way clutch permits driven gear **204**, and thereby spur gear **206**, to remain stationary and thereby not transfer any torque to generating device **220**.

Although generally described above as utilizing a series of gears, it is contemplated that transmission **200** may utilize any suitable means to provide a varying torque response over a range of motion, such as belts (FIG. **8**), friction drive, viscous couplings, or the like. With reference to FIG. **8**, in the instance where a belt is utilized to transmit the varying torque response between drive gear **202** and driven gear **204**, it is contemplated that the belt may be continuous or may terminate on drive gear **202**. In this manner, a belt **230** is secured on each end by suitable fastening devices **232**, **234**, which are fixedly secured to an outer circumference of drive gear **202**. This configuration limits the rotation of pod **120** from its first, static position (FIG. **5**A) to its maximum, or vertical position (FIG. **5**C), although it is contemplated that pod **120** may rotate 360 degrees in the instance where a continuous belt is utilized.

Referring now to FIG. **6**, an illustration of another transmission provided in accordance with the present disclosure is provided and generally referred to by reference numeral **300**. Transmission **300** is similar to that of transmission **200**, described above, and therefore in the interest of brevity, only the differences therebetween will be described below. Transmission **300** includes an elliptical drive gear **302** and a corresponding elliptical driven gear **304**. Elliptical drive gear **302** is rotatably supported on the driveshaft (not shown) at point **128***a* such that elliptical drive gear **302** rotates concentrically thereabout (i.e., elliptical drive gear **302** is not eccentrically disposed on the driveshaft). Similarly, elliptical driven gear **304** is rotatably supported on the post (not shown) at point **304***a* such that elliptical driven gear **304** rotates concentrically thereabout (i.e., elliptical driven gear **304** is not eccentrically disposed on the post). Elliptical drive gear **302** and elliptical driven gear **304** are oriented such that when pod **120** is in its initial position (FIG. **4**), the short axis **302***a* of elliptical drive gear **302** interfaces with the long axis **304***b* of elliptical driven gear **304**. In this manner, transmission **300** provides a similar effect of that of transmission **200**; however, transmission **300** permits pod **120** to rotate a full 360 degrees about point **128***a* while maintaining constant contact between elliptical drive gear **302** and elliptical driven gear **304**.

FIG. **7** illustrates another embodiment of a system provided in accordance with the present disclosure and configured for converting energy from the wave patterns of a body of water into electrical energy is shown generally identified by reference numeral **400**. System **400** is similar to that of system **100**, discussed above, and therefore in the interest of brevity, only the differences therebetween will be discussed below. A hydraulic actuator **402** is rotatably secured to platform structure **110** on a first end and rotatably secured to pod **120** on a second end. In this manner, when pod **120** is in a first, static position **404**, the hydraulic actuator **402** is fully extended. As pod **120** is caused to rotate about point **128***a*, the hydraulic actuator is caused to compress, thereby driving hydraulic fluid (not shown) through the hydraulic system (not shown), until pod **120** reaches a second, final position **406**. In this manner, hydraulic actuator **402** provides an increased resistance to the rotation of pod **120** as pod **120** is caused to rotate from the first position to the second position, similarly to the variable torque response discussed above with respect to system **100**. As the wave passes pod **120** and pod **120** is permitted to return to its first position **404**, thereby causing the hydraulic actuator **402** to expand. This motion causes hydraulic actuator **402** to pump hydraulic fluid through the hydraulic system, thereby generating electrical energy.

Referring back to FIG. **1**, a plurality of pods **120** is rotatably supported on windward end **110***a* of platform structure **110**. Pods **120** are interposed between elongate members **112**, **114** of platform structure **110** and are disposed on the outside of each of elongate members **112**, **114**. Pods **120** that are disposed outside of elongate members **112**, **114**, are rotatably supported on a driveshaft that is aligned with connective beam **118**, thereby maintaining the lateral stiffness of platform structure **110**. As can be appreciated, each of the plurality of pods **120** may be supported by means of bearings, bushings, or the like. It is further contemplated that each of the plurality of pods **120** may be fixedly secured to a driveshaft (not shown) that is rotatably supported within each of elongate members **112**, **114** using any suitable means, such as bearings, bushings, or the like. In this manner, the driveshaft rotates contemporaneously with each of pods **120**. Further, it is contemplated that transmission **200** may be disposed within or on elongate members **200**, thereby allowing pods **120** to be easily removed from platform structure **110** for service or other needs, as best illustrated in FIG. **4**B. In this manner, drive gear **202** is fixedly secured to pod **120** such that pod **120** and drive gear **202** rotate in unison. A further benefit of transmission **200** being disposed remote from pod **120** is that generating device **220** may be disposed at a location more suitable for a large or heavy device, such as in the case of a hydraulic motor or the like. It is contemplated that generating device **220** may be in mechanical communication with spur gear **206** via a belt, chain, or other suitable drive-line device. Further benefits of transmission **200** being disposed remote from pod **120** include reduced complexity of pod **120**, thereby allowing for easier manufacturing of pod **120**, and enabling platform structure **110** to be better balanced, since the heavy components of transmission **200** are maintained in a stationary location relative to platform structure **110**. This configuration reduces the stresses acting on transmission **200** and therefore allows for smaller components to be used, longer service intervals, and increased efficiency of energy generation.

Another platform structure suitable for use with pods **120** is illustrated in FIG. **1**A and generally referred to by reference numeral **1200**. Platform structure **1200** is generally similar to that of platform structure **110**, and therefore only the differences therebetween will be described in the interest of brevity. A windward end or leading end **1200***a* of platform structure **1200** includes a pair of elongate beams **1202**, **1204** extending in a transverse direction to elongate members **1206**, **1208**. Elongate beams **1202**, **1204** are arranged in a stacked orientation and include an arcuate profile when viewed from above. A plurality of U-shaped frames **1210** are interposed between each of elongate beams **1202**, **1204** and are fixedly secured to an underside of elongate beam **1202**. In this manner, the U-shaped frames **1210** are oriented in an upside down fashion, such that a pod **120** may be rotatably secured therein. This configuration enables a large number of pods **120** to be secured to platform structure **1200** while maintaining the stability of platform structure **1200** in the water. While FIGS. **1** and **1**A depict specific examples of implementation of the current disclosure, they should not be found limiting, but instead those of skill in the art will understand that the pods **120** may be deployed on a variety of structures of varying sizes without departing from the scope of the present disclosure.

FIG. **9** illustrates another platform structure incorporating the use of a plurality of pods **120**, generally referred to by reference numeral **1500**. Platform structure **1500** includes a generally circular configuration and include a lumen **1502** defined therethrough. A plurality of cutouts **1504** are defined through upper and lower ends of platform structure **1500**, each of cutouts **1504** including a pod **120** rotatably supported therein. Platform structure **1500** may include any or all of the features described above and may be free floating or may be secured to a pylon of a dock, oil rig, or a buoy for example via a tether.

With reference to FIG. **10**, yet another platform structure incorporating the use of a pod **120** is illustrated generally referred to by reference numeral **1600**. Platform structure **1600** includes an arm **1602** having a pod **120** rotatably secured thereto on a first end, and a plate **1604** fixedly secured thereto on a second end. It is contemplated that arm **1602** and plate **1604** may be integrally formed. Plate **1604** is configured to be rigidly secured by any suitable means (e.g., bolted connection, adhesives, or the like) to a large object such as a boat, dock, buoy, or the like. Arm **1602** and plate **1604** may be formed from any suitable material having sufficient rigidity to support pod **120** and to resist corrosion, such as stainless steel, cobalt chrome, composites, polymers, or the like. As can be appreciated, platform structure **1600** may include any or all of the features described above.

Turning now to FIG. **11**, still another platform structure incorporating the use of a pod **120** is illustrated generally referred to by reference numeral **1700**. Platform structure **1700** is similar to platform structure **1600**, except arm **1702** is rigidly fixed to the seabed **1704** close to shore, thereby minimizing the size of platform structure **1700**. It is contemplated that pod **120** may be rotatably supported by arm **1702** in a cantilever manner or arm **1702** may include a pair of tabs **1706** extending vertically therefrom such that a driveshaft (not shown) rotatably supporting pod **120** may be supported on either end. As can be appreciated, platform structure **1700** may include any or all of the features described above.

It is contemplated that system **100** may include a beacon **140** disposed thereon. Although generally shown as being disposed on stabilizing beam **116**, it is contemplated that beacon **140** may be disposed at any suitable location on platform structure **110** or separated therefrom (for example on a platform extending away from the platform to windward. Beacon **140** may be any suitable device capable of transmitting and receiving information regarding oceanic events, such as tides, wave height, the presence of storms, etc. Beacon **140** may include a suitable computer (not shown) capable of executing a program stored on a suitable storage medium (not shown), such as flash memory, a hard drive, or the like. Beacon **140** includes a global positioning system (GPS) such that beacon **140** may transmit the location of beacon **140** to enable oceanic information to be transmitted wireless thereto in order to cause system **100** to adjust to the oceanic conditions at that particular location. In addition, beacon **140** may instruct a ballasting system **1300** (FIGS. **19**A and **19**B) to cause system **100** to submerge ahead of a storm or other event that may imperil system **100**, as will be discussed in further detail below.

Continuing with FIG. **1**, system **100** further includes a wave measuring device **150** rigidly secured to platform structure **110**. Wave measuring device **150** includes a buoy **152** slidably or rotatably disposed thereon that is partially submerged in the water. Buoy **152** is buoyant, and therefore is coupled to the water such that it follows the waves as they pass under platform structure **110**. In this manner, buoy **152** measures the instantaneous wave height and wave period of the waves passing under platform structure **110**. This information is stored in a suitable storage medium of a computer (not shown) containing an executable program capable of receiving the data, interpreting the data, and sending commands.

The wave height and wave period measurements are used to determine whether ballasting system **1300** (FIGS. **19**A and **19**B) should submerge system **100**, as will be discussed in further detail below. It is further contemplated that wave measuring device **150** may be used to instantaneously adjust an electromagnetic generator (not shown) disposed in pod **120** in lieu of generator **220** or transmission **200**. In this manner, the electromagnetic generator may be in mechanical cooperation with drive gear **202**, and the torque response provided by the electromagnetic generator may be increased or decreased as a result of the measurements gathered by wave measuring device **150**.

With reference to FIG. **12**, an illustration of a hydraulically actuated electrical generation system **500** provided in accordance with the present disclosure. Although generally shown as being disposed in a head **160** disposed on platform structure **110**, electrical generation system **500** may be disposed in any suitable location, whether on platform structure **110**, within platform structure **110**, or remote from platform structure **110**. Each pod **120** includes a corresponding electrical generation system **500**, although other configurations are also contemplated, such as coupling one or more pods **120** to a single electrical generator **502**.

A schematic of a hydraulic circuit **600** is illustrated in FIG. **13** corresponding to a pod **120** including a hydraulic rotary actuator **602**. Hydraulic rotary actuator **602** may be any suitable rotary actuator known in the art, such as a rack and pinion, vane, or the like. An input shaft (not shown) of hydraulic rotary actuator **602** is fixedly secured to pinion gear **222**, thereby being in mechanical communication with transmission **200**. Hydraulic rotary actuator **602** is hydraulically coupled to a fluid source **604** having a first one way valve **604***a*. First one way valve **604***a* is configured to permit the passage of fluid only out of fluid source **604** and into hydraulic rotary actuator **602**, such that hydraulic rotary actuator **602** may only draw fluid therein, and not expel fluid back into fluid source **604**. A hydraulic line **606** is hydraulically coupled to hydraulic rotary actuator **602** and includes a second one way valve **606***a* in hydraulic communication therewith. Second one way valve **606***a* is configured to permit the passage of fluid from hydraulic rotary actuator **602**, and prohibit fluid from being drawn back into hydraulic rotary actuator **602**. An accumulator **608** is also disposed on hydraulic line **606** and is in hydraulic communication therewith. Accumulator **608** is disposed downstream of second one way valve **606***a*. Continuing further downstream, a hydraulic motor **610** is disposed on hydraulic line **606** and is in hydraulic communication therewith. Hydraulic motor **610** is hydraulically coupled to fluid source **604**, such that any fluid drawn in by hydraulic rotary actuator **602** is expelled into fluid source **604** after passing therethrough. The combination of the first and second one way valves **604***a*, **606***a*, ensures that the fluid may only be forced into the hydraulic motor **610**, and not back into the fluid source **604**. In this manner, the fluid is pressurized between the hydraulic rotary actuator **602** and the hydraulic motor **610**, thereby causing the hydraulic motor **610**, and in turn an electrical generator **612** (or electrical generator **502** of FIG. **12**) mechanically coupled to an output shaft (not shown) of the hydraulic motor **610**, to rotate, thereby generating electrical energy. The low pressure fluid expelled from the hydraulic motor is then returned to the fluid source **604**. An alternative hydraulic circuit **600** is illustrated in FIG. **13**A.

Referring now to FIG. **14**, another hydraulic schematic is provided illustrating hydraulic circuit **700** is provided. Hydraulic circuit **700** corresponds to system **100** including a hydraulic pump **702** mechanically coupled to transmission **200**. In this manner, pinion gear **222** is fixedly disposed on an output shaft (not shown) of hydraulic pump **702**. Hydraulic system **700** includes a high pressure line **704** hydraulically coupled to a high pressure side of hydraulic pump **702** and terminating in a high pressure side of hydraulic motor **708**. High pressure line **704** includes a first one way valve **704***a* disposed upstream of a high pressure or first accumulator **704***b*. A low pressure line **706** is hydraulically coupled to a low pressure side of hydraulic motor **708** and terminates at a low pressure side of hydraulic pump **702**. Low pressure line **706** includes a low pressure or second accumulator **706***b* disposed upstream of a second one way valve **706***a*. Hydraulic system **700** is a closed loop system and therefore, the combination of first and second one way valves **704***a*, **706***a*, causes the fluid to only flow in a direction from hydraulic pump **702** to hydraulic motor **708**. In this manner, hydraulic pump causes the fluid in high pressure line **704** to increase in pressure and drive hydraulic motor **708**, and in turn an electrical generator **710** (or electrical generator **502** of FIG. **12**) mechanically coupled to an output shaft (not shown) of the hydraulic motor **708**, thereby generating electrical energy. The low pressure fluid expelled by hydraulic motor **708** is returned to hydraulic pump **702** via low pressure line **706**, thereby completing the hydraulic loop.

FIG. **15** illustrates yet another hydraulic circuit **800** provided in accordance with the present disclosure. Hydraulic circuit **800** corresponds to system **400** including a hydraulic actuator **402**, which may be any suitable linear hydraulic actuator. A first high pressure line **804** is hydraulically coupled to a first chamber **402***a* of hydraulic actuator **402**, and a second high pressure line **806** is hydraulically coupled to a second chamber **402***b*. Each of high pressure lines **804**, **806** includes a corresponding first and second one way valve **804***a*, **806***a*, configured to permit fluid flow only in a direction flowing away from hydraulic actuator **402**. High pressure lines **804**, **806** converge into a high pressure hydraulic conduit **808** that terminates in at a high pressure end of a hydraulic motor **810**. High pressure conduit **808** includes a high pressure or first accumulator **808***a* disposed between hydraulic motor **810** and first and second one way valves **804***a*, **806***a*. A low pressure conduit **812** is hydraulically coupled to a low pressure side of hydraulic motor **810** and diverges into a first low pressure line **814** and a second low pressure line **816**. First low pressure line **814** is hydraulically coupled to first chamber **402***a* of hydraulic actuator **402** and second low pressure line **816** is hydraulically coupled to second chamber **402***b* of hydraulic actuator **402**. Each of first and second low pressure lines **814**, **816** includes a corresponding third and fourth one way valve **814***a*, **816***a*, configured to permit fluid flow only in a direction flowing into hydraulic actuator **402**. Low pressure conduit **812** includes a low pressure or second accumulator **812***a* disposed thereon between hydraulic motor **810** and first and third and fourth one way valves **814***a*, **816***a*. The rotation of pod **120**, and therefore the compression and extension of hydraulic actuator **402**, pressurizes the fluid contained within system **800**, drives the hydraulic motor **810**, and in turn drives an electrical generator **818** (or electrical generator **502** of FIG. **12**) mechanically coupled to an output shaft (not shown) of the hydraulic motor **810**, thereby generating electrical energy. The low pressure fluid expelled by hydraulic motor **810** is returned to the low pressure side of the hydraulic actuator **402** via low pressure conduit **812**, thereby completing the hydraulic loop.

As noted above, it is contemplated that one or more pods **120** may be included in system **100**. As can be appreciated, each pod **120** may include a single hydraulic circuit (i.e., hydraulic circuits **600**, **700**, **800** discussed above) including a single electrical generator, or the hydraulic circuits of a plurality of pods **120** may be hydraulically coupled to form a single hydraulic circuit driving a single electrical generator.

FIG. **16** illustrates a hydraulic system **900** including a plurality of pods **120**, and therefore a plurality of hydraulic circuits. Although shown with three hydraulic circuits, it is contemplated that any number of hydraulic circuits may be coupled together to drive the electrical generator **908**. As can be appreciated, hydraulic system **900** may include identical hydraulic circuits (i.e., all hydraulic circuit **600**), or may include any combination of hydraulic circuits **600**, **700**, and/or **800**. As illustrated in FIG. **11**, hydraulic system **900** includes one of each of hydraulic circuits **600**, **700**, and **800**. Each of hydraulic circuits **600**, **700**, and **800** are disposed in a parallel configuration, and include a high pressure line **902***a* on a high pressure side **902** and a low pressure line **904***a* on a low pressure side **904**. A hydraulic motor **906** is disposed at the end of hydraulic system **900** and is in hydraulic communication with each of the high pressure line **902***a* and low pressure line **904***a*. An output shaft (not shown) of the hydraulic motor **906** is in mechanical communication with an electrical generator **908** (or electrical generator **502** of FIG. **12**). A high pressure accumulator **902***b* is hydraulically coupled to the high pressure line **902***a* between the final hydraulic circuit and the hydraulic motor **906**, and a low pressure accumulator **904***b* is hydraulically coupled to the low pressure line **904***a* between the hydraulic motor **906** and the final hydraulic circuit. A filter **904***c* including a differential pressure switch is hydraulically coupled to the low pressure line **904***a* between the low pressure accumulator **904***b* and the final hydraulic circuit, thereby removing any contaminants from the hydraulic system **900** before re-entering each of the hydraulic circuits **600**, **700**, and **800**. Each of the hydraulic circuits **600**, **700**, **800** contributes to pressurizing the hydraulic fluid contained within high pressure line **902***a*. As can be appreciated, each of the hydraulic circuits **600**, **700**, **800** may contribute to the pressurization of the hydraulic fluid in an individual capacity. In this manner, the pods **120** are not required to simultaneously contribute to the pressurization and may move independent of each other. Indeed, the combination of each of the one way valves, **606***a*, **704***a*, **804***a*, and **806***a* of respective hydraulic circuits **600**, **700**, and **800** ensure that high pressure hydraulic fluid may not flow back into any of the hydraulic rotary actuator **602**, hydraulic pump **702**, or hydraulic actuator **402**. A further benefit of individual contributions to pressurizing the hydraulic fluid is that there are fewer pressure drops as the pressurized hydraulic fluid drives the hydraulic motor **906** (i.e., a more continuous flow/pressure is provided), thereby providing a more continuous generation of electrical energy. An alternative hydraulic system **900** is illustrated in FIG. **16**A.

FIG. **17** illustrates another hydraulic system **1000** having a plurality of hydraulic circuits hydraulically coupled thereto. Hydraulic system **1000** is similar to hydraulic system **900** discussed above, and therefore, only the differences therebetween will be discussed in the interest of brevity. Hydraulic system **1000** includes a high pressure tee **1002** having a first gate valve **1002***a* hydraulically coupled thereto, ultimately terminating at a high pressure side of hydraulic motor **906** (FIG. **16**). First gate valve **1002***a* is disposed upstream of hydraulic motor **906** and may be any suitable gate valve capable of cutting off the flow of hydraulic fluid to hydraulic motor **906**. Hydraulic system **1000** further includes a low pressure tee **1004** having a second gate valve **1004***a* hydraulically coupled thereto, ultimately terminating at a low pressure side of hydraulic motor **906**. Second gate valve **1004***a* is disposed downstream of hydraulic motor **906** and may be any suitable gate valve capable of cutting off the flow of hydraulic fluid from hydraulic motor **906**. It is contemplated that first and second gate valves **1002***a*, **1004***a* may be a manual gate valve, automatic gate valve, or the like. In combination, when first and second gate valves **1002***a*, **1004***a* are shut, hydraulic circuits **600**, **700**, and **800** are isolated from hydraulic motor **906**. In this manner, service may be performed on either hydraulic motor **906** or any of the hydraulic circuits **600**, **700**, or **800**.

Referring now to FIG. **18**, a hydraulic system **1100** capable of individually isolating each of the hydraulic circuits **600**, **700**, and **800** is illustrated. Hydraulic system **1100** is similar to hydraulic system **1000**, discussed above, and therefore only the differences therebetween will be discussed in the interest of brevity. Hydraulic system **1100** includes three hydraulic circuits hydraulically coupled to form hydraulic system **1100**. The first two hydraulic circuits, **600**, **700** include a high pressure tee **1102** and a low pressure tee **1104** interposed therebetween. Each of the hydraulic circuits **600**, **700**, include a respective high pressure gate valve, **1106**, **1108**, and a respective low pressure gate valve **1110**, **1112** disposed adjacent to each of the high pressure tee **1102** and low pressure tee **1104**. Additionally, third hydraulic circuit **800** includes a high pressure line **1114** hydraulically coupled to high pressure tee **1102** and a low pressure line **1116** hydraulically coupled to low pressure tee **1104**. Third hydraulic circuit **800** includes a high pressure gate valve **1118** disposed adjacent to high pressure tee **1102** and a low pressure gate valve **1120** dispose adjacent to low pressure tee **1104**. Similarly to hydraulic system **1000**, each of the high pressure tee and low pressure tee includes a respective gate valve **1122**, **1124**. In this manner, hydraulic system **1100** may be selectively isolated from a hydraulic motor (not shown), or, as desired, each hydraulic circuit **600**, **700**, and/or **800** may be individually isolated from the rest of hydraulic system **1100**.

As can be appreciated, each of hydraulic circuits **600**, **700**, **800**, and each of hydraulic systems **900**, **1000**, **1100** may include a redundant circuit hydraulically coupled to a respective hydraulic motor. In this manner, if an issue arises with one hydraulic motor, that particular circuit may be isolated while maintaining the ability to generate electrical energy while a technician performs service or repairs to the affected circuit.

As illustrated in FIGS. **19**A and **19**B, system **100** includes a ballasting system **1300** capable of submerging system **100** in the event a storm. Ballasting system **1300** includes a mooring **1302** resting on a seabed **1304** and a mooring line **1306** fixedly secured to the mooring **1302** at a first end and fixedly secured to the windward end **110***a* of platform structure **110** using any suitable means. Mooring **1302** may be any suitable mooring, such as a swing mooring, fore and aft mooring, pile mooring, or the like. It is contemplated that mooring line may be any suitable line such as a chain, rope, steel cable, or the like and may include a suitable electrical line (not shown) attached thereto; however, it is contemplated that mooring line **1306** may be capable of transmitting electrical energy generated by system **100**, and then transmitted back to shore or a floating electrical substation (not shown) via an undersea cable **1308**. Ballasting system **1300** may include a pump (not shown) capable of drawing water from the sea within chambers (not shown) defined within each of elongate members **112**, **114** of platform structure **110**; although other configurations are also contemplated, such as air pumps, stand-alone water/air chambers, or the like. In the event of a storm or other natural event that would imperil system **100**, the ballasting system draws water into the chambers (or expels air) in order to submerge system **100** (FIG. **19**B). It is contemplated that ballasting system **1300** may submerge system **100** a certain depth beneath the sea or may submerge system **100** until platform structure **110** rests on the sea bed **1304**. The depth at which system **100** is submerged is dependent upon the depth of the sea and the intensity of the storm.

Referring now to FIGS. **20** and **21**, an illustration of another system capable of extracting energy from waves is provided and generally referred to by reference numeral **1400**. System **1400** includes a head or platform structure **1402** disposed at a windward or leading end **1400***a*. Head **1402** includes an arcuate beam **1404** having ends that curve and extend towards a leeward or trailing end **1400***b*. Head **1402** includes a compartment **1406** disposed on arcuate beam **1404** at a location that bisects arcuate beam **1404**, although other configurations are also contemplated. A plurality of tails **1408**, each consisting of a plurality of interconnected elongate members **1410**, is rotatably secured to an underside of arcuate beam **1404** at equally spaced locations along arcuate beam **1404**. Each of the plurality of interconnected elongate members **1410** is rotatable secured to the next, such that each elongate member **1410** may conform to the shape of a wave that is passing thereunder. In order to extract energy from the waves, each elongate member of the plurality of elongate members includes at least one hydraulic actuator **1412** (FIG. **21**) that is rotatably supported on a leading elongate member **1410***a* on a first end, and is rotatably supported on a trailing elongate member **1410***b* on a second end. In this manner, as each elongate member articulates (i.e., follows the shape of the wave), the hydraulic actuator **1412** is compressed or extended, thereby pumping hydraulic fluid throughout a hydraulic system (not shown) disposed on or within head **1402**.

As can be appreciated, the hydraulic circuit used for each hydraulic actuator may be similar to hydraulic circuit **800**, discussed above, and the hydraulic system (not shown) hydraulically coupling each hydraulic circuit may be similar to any of hydraulic systems **900**, **1000**, or **1100** discussed above. It is contemplated that compartment **1406** may be watertight and may include an electrical generator (not shown) and other hydraulic components (e.g., accumulators, gate valves, etc.), thereby shielding such components from the sea and other elements.

It is contemplated that system **1400** may include any or all of the components or systems described above, such as ballasting system **1300**, beacon **140**, and/or wave measuring device **150**.

It is further contemplated that the electrical power generated using any of the above embodiments may be used to generate and store hydrogen. In this manner, the electrical energy extracted from the waves may power an electrolyzer (not shown) fixedly secured to platform structure **110**. The electrolyzer may be any suitable electrolyzer capable of decomposing water into oxygen and hydrogen gas and is in electrical communication with the electrical generator **502** (FIG. **12**). The generated hydrogen may then be separated from the oxygen using any suitable means known in the art and may be stored within suitable tanks (not shown) capable of storing and selectively releasing the hydrogen gas. It is contemplated that the tanks may be disposed within elongate members **112**, **114** of platform structure **110**, may be disposed at any suitable location on platform structure **110**, or may be located remote from platform structure **110**. As can be appreciated, any of the above described systems may include the ability to both generate hydrogen and transmit electricity, either simultaneously or selectively by means of a switch (not shown) or any other suitable means. It is further contemplated that the oxygen gas separated from the water by the electrolyzer may be utilized in ballasting system **1300**.

While several embodiments of the disclosure have been shown in the drawings, it is not intended that the disclosure be limited thereto, as it is intended that the disclosure be as broad in scope as the art will allow and that the specification be read likewise. Therefore, the above description should not be construed as limiting, but merely as exemplifications of particular embodiments.

What is claimed is:

**1**. A wave energy conversion system, comprising:

a pod rotatably supported by a platform structure;

a multi-radius energy transmission mechanism in mechanical communication with the pod, the multi-radius energy transmission mechanism including a plurality of gears, each gear of the plurality of gears having an elliptical profile and being rotatably supported at a centerpoint thereof, wherein the plurality of gears cooperate to provide increasing resistance to rotation of the pod as the pod is rotated in a first direction; and

an electrical generating device in mechanical communication with the multi-radius energy transmission mechanism.

**2**. The wave energy conversion system according to claim **1**, wherein the pod is buoyant and is configured to be rotated in the first direction as a wave contacts a planar side surface disposed on a leading side of the pod.

**3**. The wave energy conversion system according to claim **2**, wherein the multi-radius energy transmission mechanism includes a drive gear rotatably supported on a drive-shaft extending through the center of rotation of the pod.

**4**. The wave energy conversion system according to claim **3**, wherein the drive gear is mechanically coupled to the pod.

**5**. The wave energy conversion system according to claim **4**, wherein the multi-radius energy transmission mechanism includes a driven gear rotatably supported on a post fixedly secured to the platform structure.

**6**. The wave energy conversion system according to claim **1**, wherein rotation of the pod initiates rotation of the drive gear about the driveshaft, thereby initiating a rotation of the driven gear about the post.

**7**. The wave energy conversion system according to claim **6**, wherein a radius of the drive gear at a location adjacent the driven gear increases as the drive gear rotates.

**8**. The wave energy conversion system according to claim **7**, wherein a radius of the driven gear at a location adjacent the drive gear decreases as the driven gear rotates, thereby transmitting a variable torque.

**9**. The wave energy conversion system according to claim **1**, wherein the multi-radius energy transmission mechanism includes a spur gear rotatably supported on the post.

**10**. The wave energy conversion system according to claim **9**, wherein the spur gear is in mechanical communication with the driven gear and the electrical generating device.

**11**. The wave energy conversion system according to claim **1**, wherein the electrical generating device includes a hydraulic circuit.

**12**. The wave energy conversion system according to claim **11**, wherein the hydraulic circuit includes a hydraulic actuator in mechanical communication with the multi-radius energy transmission mechanism.

**13**. The wave energy conversion system according to claim **12**, wherein the hydraulic actuator is in hydraulic communication with a hydraulic motor, wherein actuation of the hydraulic actuator causes the hydraulic motor to rotate, thereby causing an electrical generator in mechanical communication therewith to generate electrical energy.

**14**. A wave energy conversion system, comprising:

a pod rotatably supported by a platform structure;

a multi-radius energy transmission mechanism in mechanical communication with the pod, the multi-radius energy transmission mechanism including a plurality of gears, each gear of the plurality of gears being rotatably supported at a point other than a centerpoint thereof, wherein the plurality of gears cooperate to provide increasing resistance to rotation of the pod as the pod is rotated in a first direction; and

an electrical generating device in mechanical communication with at least one gear of the plurality of gears.

**15**. A wave energy conversion system, comprising:

a pod rotatably supported by a platform structure;

a multi-radius energy transmission mechanism in mechanical communication with the pod, the multi-radius energy transmission mechanism including a plurality of gears, wherein as the pod rotates in a first direction, a radius of a first gear of the plurality of gears increases and a radius of a second gear of the plurality of gears decreases at a mesh point therebetween to provide increasing resistance to rotation of the pod as the pod is rotated in the first direction; and

an electrical generating device in mechanical communication with at least one gear of the plurality of gears.

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